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IDENTIFIERS	*Workplace Literacy

ABSTRACT

Employee and facilitator manuals are provided for two courses developed for a workplace literacy program: Mathematics on the Job I and II. Each 10-session course begins with a preassessment and ends with a postassessment. Components of each 2-hour session are objectives, informational materials, and problems or exercises. The facilitator copies include the answer keys. Topics covered in the first course include the following: read and write whole numbers; add and subtract whole numbers; solve addition and subtraction word problems; multiply and divide whole numbers; use calculators; solve multiplication and division word problems; use fractions; convert from fractions to decimals; add and subtract decimals; multiply and divide decimals; convert decimals to percents; solve decimal word problems; and solve work-related problems. Topics covered in the second course are as follows: math anxiety; problem solving; fractions; fraction word problems; decimals; decimal word problems; percentages; percentage word problems; converting between fractions, decimals, and percents; number line; positive and negative integers; addition and subtraction of positive and negative integers; multiplication and division of positive and negative integers; the rules for order of operations for solving equations; formulas; using formulas to solve job-related problems; ratio and proportion; and ratio and proportion word problems. (YLB)

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ED 366 761

CWP
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Mathematics

on-the-job

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CE 065 596

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CLEVELAND WOOD PRODUCTS

MATHEMATICS ON THE JOB I

SESSION OVERVIEW

Ten 2-hour sessions

Session 1
How to Study Math
Pre-Assessment

Session 2
Read and Write Whole Numbers
Add and Subtract Whole Numbers

Session 3
Solving Addition and Subtraction Word Problems
Multiplying and Dividing Whole Numbers

Session 4
Introduction to Calculators
Solving Multiplication and Division Word Problems

Session 5
Introduction to Fractions
Converting from Fractions to Decimals

Session 6
Adding and Subtracting Decimals
Solving Decimal Word Problems

Session 7
Multiplying and Dividing Decimals
Solving Decimal Word Problems

Session 8
Converting Decimals to Percents
Solving Decimal Word Problems

Session 9
Work-Related Problems
Additional Decimal Word Problems

Session 10
Post-Assessment
Conclusion

MATHEMATICS ON THE JOB I
PRE-ASSESSMENT

I. Write the following as whole numbers:

A. Four hundred thousand nine hundred eighty-six

____

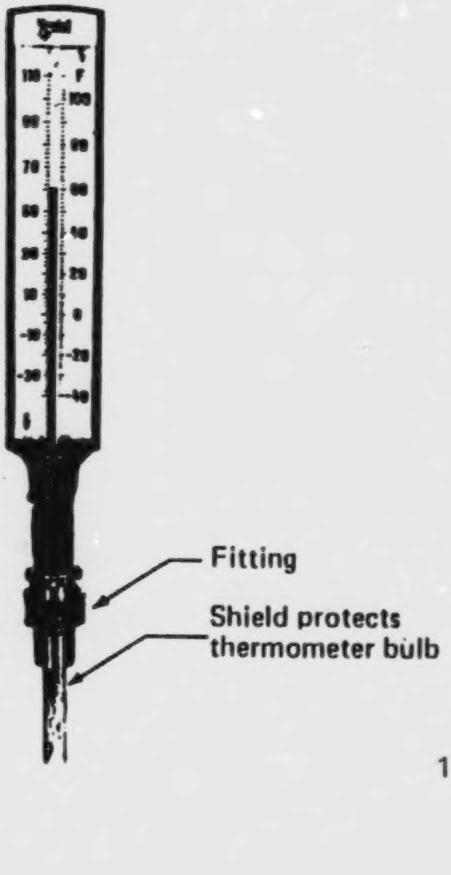
B. Seven million eight hundred twenty-one thousand one hundred thirty-three

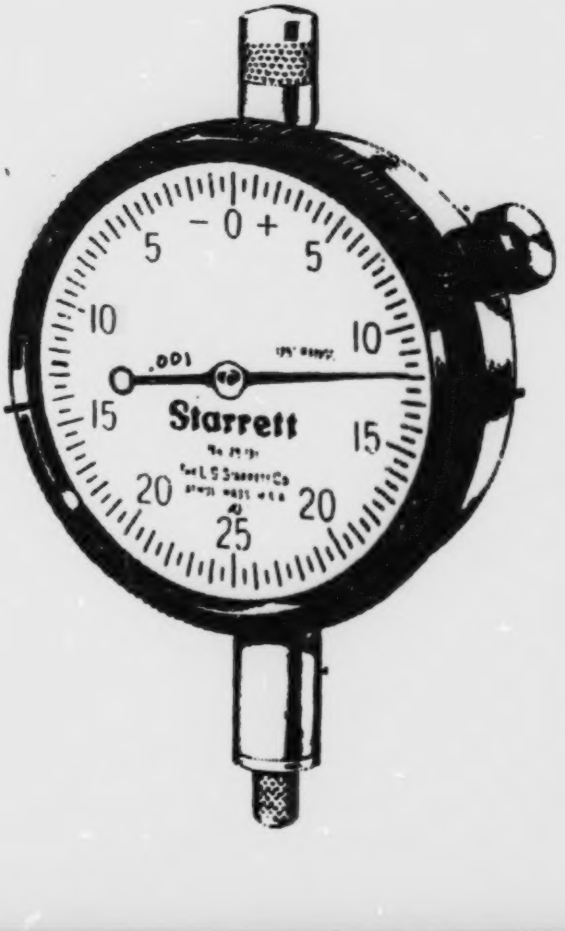
____

II. A. The mercury on this thermometer reads at _______ degrees F.

B. The dial on this indicator points to the number _________.

This is read as _______________.


Fitting
Shield protects thermometer bulb


− 0 +
5
5
10
10
.001
15
15
Starrett
20
20
25

III. Add the following numbers:

A.

$$\begin{array}{r} 415 \\ +\ 932 \\ \hline \end{array}$$

B.

$$\begin{array}{r} 18{,}441 \\ 59{,}609 \\ +\ 23{,}484 \\ \hline \end{array}$$

IV. Subtract the following numbers:

A.

$$\begin{array}{r} 495 \\ -\ 23 \\ \hline \end{array}$$

B.

$$\begin{array}{r} 88 \\ -\ 74 \\ \hline \end{array}$$

V. Solve the following problems:

A. An automatic machine requires servicing after every 300 hours of operation. If the operating-time indicator now reads 193 hours, how many hours remain before the next service is required?

B. Add the Pieces Scrapped due to cracked wood at the bearing assembly.

____

SCRAP:

CRACKED WOOD AT BEARING ASSY.	185	101	86	31		45	
HIT[illegible]S)							
DEFECT IN WOOD							
NOT LOCKED IN (BRISTLER)	4	1	3	5	5	4	
SET-UP SCRAP		2	7	3	1	5	
TOO SHORT		1			1		
NO PAINT ON ONE SIDE	1		1		2		
INITIALS:						TOTAL SCRAP =	

VI. Multiply the following numbers:

A.
```
  812
x 716
-----
```

B.
```
  8,421
x    18
-------
```

VII. Divide the following, and indicate the remainder, if any.

A. 184 ÷ 23 =

B. 64 | 9245

VIII. Solve the following problems:

A. Yesterday, 347 boxes of 32 brush assemblies each were packed in your department. How many brush assemblies total were packed?

B. Find the average number of pieces reworked due to Bernelled Bearings.

____

PART NUMBER: 661912-003 - RYOBI 12" BALL BEARING BRUSHROLL ASSY.
661912-004 - RYOBI 14" BALL BEARING BRUSHROLL ASSY.
661912-006 - RYOBI 14" BALL BEARING BRUSHROLL ASSY. (4 ROW)

REWORK AND SCRAP REPORT

SHIFT:

	MON	TUES	WED	THURS	FRI	SAT	TOTAL
LIST DATES HERE: REWORK:	3/6/93	3/7/93	3/8/93	3/9/93	3/10/93	3/11/93	
BERNELLED BEARING(S)	21	22	45	29	3	6	
MISSING TUFT(S)	18	19	13	7	4	7	

TOTAL REWORK =

IX. Convert the following:

A. Write the fracion equivalent of .500. ________________

B. What is the decimal equivalent of 1/4? ________________

X. Add the following decimal numbers:

A. .836 + 1.59 + 42.64 = ______

B. 49.23 + .80 + 7.41 = ______

XII. Subtract the following decimal numbers:

A. 18.449 - .671 = ______

B. 8.224 - .55 = ______

XIII. Solve the following problems using the Rework and Scrap Report given below for 12" Ball Bearing Brushroll Assemblies:

SCRAP:

CRACKED WOOD AT BEARING ASSY.	185	101	86	31		45	
HIT OFF(S)							
DEFECT IN WOOD							
NOT LOCKED IN (BRISTLER)	4	1	3	5	5	4	
SET-UP SCRAP		2	7	3	1	5	
TOO SHORT		1			1		
NO PAINT ON [illegible]E SIDE	1		1		2		
INITIALS:						TOTAL SCRAP =	

A. How many brushroll assemblies were scrapped during the week because they were not locked in? ____________

B. If each piece of scrap costs Cleveland Wood Products $4.00, what is the expense for all brushroll assemblies scrapped (for any reason) during this week? ____________

XIV. Multiply the following decimal numbers:

A. 8.83 x 92.4 = ______

B. .855 x 1.5 = ______

XV. Divide the following decimal numbers. Carry your answers out to 3 decimal places.

A. 82.4 ÷ .58 = ______

B. 77.51 ÷ 8.9 = ______

XVI. Solve the following problems:

A. You worked 187.5 hours in 2.5 weeks. How many hours did you average per week? ____________________

B. You can earn 2 vacation days each month. How many days of vacation would you have at the end of 6.5 months? ____________________

XVII. Solve the following word problems.

A. Currently, Tina paints 475 dowels a day. She needs to increase her production by 7%. How many dowels will she need to paint each day?

____

B. Anna works overtime every week; she is paid time and a half for any hours over 40 each week. Her hourly wage is $12.50. In February of this year, Anna worked 55 hours the first week, 63 hours the second week, 42 hours the third week and 60 hours the last week. How much did Anna earn (before taxes or other deductions were taken out of her check)?

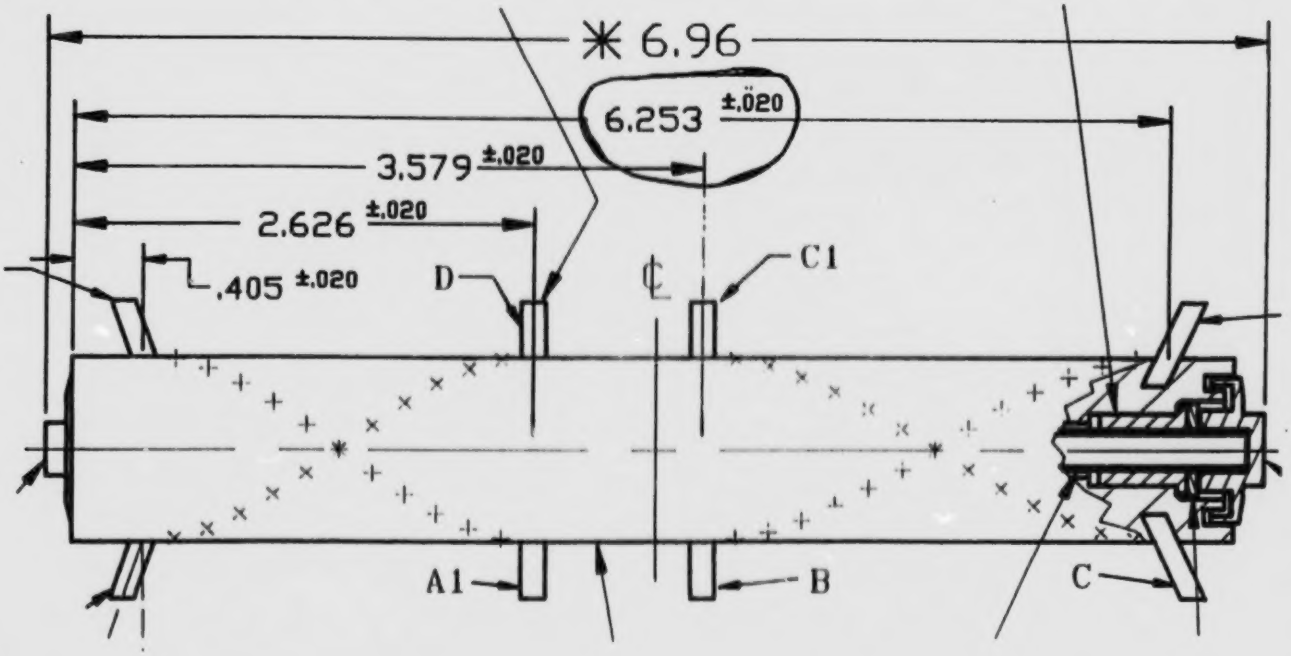
____

C. You accrue sick time at the rate of .5 days per every 2 months worked. At the end of one year, how much sick time have you accrued?

____

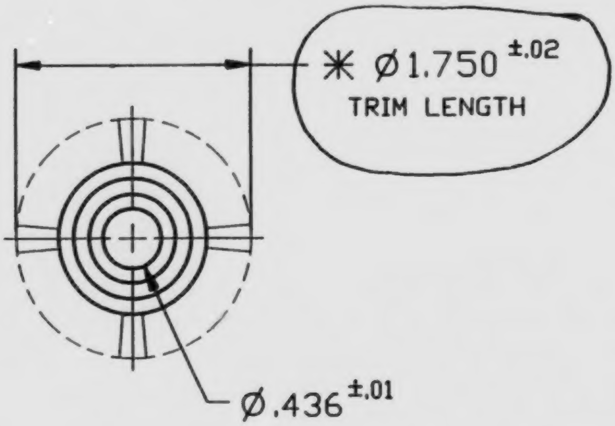
D. Find the upper (+) tolerance on the circled length.

____


✳ 6.96
6.253 ±.020
3.579 ±.020
2.626 ±.020
.405 ±.020
D
℄
C1
A1
B
C

E. What is the lower (-) tolerance for the circled dimension?

____


✳ Ø1.750 ±.02
TRIM LENGTH
Ø.436 ±.01

CLEVELAND WOOD PRODUCTS

MATHEMATICS ON THE JOB I

OBJECTIVES

SESSION I

- State an increased comfort with math and express increased self-confidence with math skills.

MATHEMATICS ON THE JOB I
SESSION 1

GOALS FOR MATHEMATICS ON THE JOB I

The Mathematics on the Job I course will provide you with:

- An opportunity to learn/review math skills necessary to effectively perform your job.

- An increased understanding of how important math is to your job, and to our technological society.

- The training and practice necessary to help you feel more comfortable with math and to increase your self-confidence with your math skills.

MATHEMATICS ON THE JOB I
SESSION 1

PERSONAL MATH GOALS

It's important to know what your personal goals for math are. Take a few minutes and write down something that you would like to accomplish in this Mathematics on the Job I class.

MY PERSONAL MATH GOAL IS:

SOME REASONS FOR MATH ANXIETY

- **Past Conditioning** - We were told that we weren't good at math or we were "tracked" in high school and assumed we didn't need or couldn't learn math.

- **Can't see the need for math** - Often when we're younger, we fail to see the importance of math to our future or our daily work lives. Now that we have jobs that require us to use math, it becomes much more relevant.

- **We believe myths about math**

  1. Math is hard and complicated to learn.

     Math is different from learning vocabulary or how to read a blueprint. But math isn't as mysterious or complicated as we may have been led to believe. Everyone in this room has the ability to learn math.

  2. Math is for eggheads.

     Everyone needs and can learn math. And you don't necessarily have to have a "mathematical mind" to understand math. Sure, the eggheads may need and use theory more, but math skills and reasoning are useful and learnable by people at many different levels.

- **Not enough experience using math**

  Maybe until now, you never had much need for math. So, you probably don't have a lot of math experience. This class, will, of course, provide experience. And as you practice math skills, you'll feel more comfortable with your math abilities.

OTHER REASONS FOR MATH ANXIETY:

____

____

MATHEMATICS ON THE JOB I
SESSION 1

WHAT YOU CAN DO TO GET AND KEEP A POSITIVE ATTITUDE

- **Believe in yourself.**

- **Tell yourself you know you can do it!**

  You can use affirmations/positive statements to help you in this area. Come up with a positive statement about your ability to learn math. Repeat this to yourself several times daily. Also, whenever negative thinking creeps in, stop, and replace those negative thoughts with your new positive statement.

- **Stay relaxed.**

  If you find yourself getting frustrated, take a break, mental or physical, for a few minutes. Then approach the problem or concept again.

- **Get rid of "all-or-nothing," have-to-be-perfect attitudes.**

  Yes, the right answer is important in math, but you're learning. So, give yourself credit for what you do right!

WAYS I PLAN TO WORK ON A POSITIVE ATTITUDE:

MATHEMATICS ON THE JOB I
SESSION 1

POSITIVE MATH STATEMENT

In order to replace outdated, negative attitudes with new, positive attitudes, we need to have a positive statement about our math abilities, to repeat to ourselves several times daily and to use when negative thinking creeps in.

Take a few minutes now to write a 1-sentence positive statement about your ability to learn and/or use math. Memorize or refer to this statement often, so you can repeat it to yourself whenever you need or want to. Some people like to put these statements on index cards for easy reference.

MY POSITIVE MATH STATEMENT:

Using this technique will help you gain self-confidence and bring you closer to achieving math success.

MATHEMATICS ON THE JOB I
SESSION 1

WHAT TO EXPECT

- **Math is a process**

- **Math is learned by doing, not just observing**

  In this class, there will be lots of opportunities to practice working problems. If you need more practice, there are software programs available in the learning lab and extra problem sets can be obtained from the instructor.

- **Everyone learns math at different rates and approaches problems a little differently**

MATHEMATICS ON THE JOB I
SESSION 1

WHAT'S EXPECTED

To succeed in math, you'll need to do the following:

- **Attend classes**

  Missing a class automatically puts you behind since math builds on skills. If you have to miss a class, contact the instructor. He or she can fill you in on what you'll be missing, and direct you to appropriate exercises and software to help you catch up quickly.

- **Participate in class**
  - Ask questions when you're lost.
  - Actively participate in class and team activities.
  - Complete in-class assignments.

- **Listen actively and take effective notes**
  - Try to follow what the instructor's saying even if you can't make sense of it all, right away. (And don't be shy about asking questions.)
  - Take neat, meaningful notes. This will help you to make sense of what was discussed later on.

- **Practice, practice, practice.**

  As mentioned earlier, this is the best way to learn math.

MATHEMATICS ON THE JOB I
SESSION 1

MATH NOTETAKING AND STUDY TIPS

Notetaking Tips

Tip # 1: **Be neat.**

In math, neatness counts!! You need to be able to follow the problem-solving process, both in your notes and when working problems.

Tip # 2: **Write down the problem as the instructor works it out on the board and write down your explanation of the steps in the process.**

This will help you to understand the process and your notes will be a lot more useful because they won't just be a bunch of numbers.

Notetaking Example

Adding 2 Numbers

Problem	Process
142	1. Add numbers in Ones place.
+ 14	2. Add numbers in Tens place.
	3. Add numbers in Hundreds place.
156	(If there isn't a number in a place, treat as a 0.)

Tip # 3: **Copy down all definitions and principles.**

It's important that you know and understand these. They'll be used over and over again in class and for explanations.

Tips for Reviewing Your Notes

Tip # 4: **Rework the example problems.**

Before you go on to the uncharted territory of practice problems, be sure you can work the known territory of the example problems in your notes. If you get stuck on the example problem, you can ask the instructor for clarification. This will save you time and frustration when you're out there on your own with the practice problems.

Study Tips

Tip # 5: **Make sure you can explain the process for working different types of problems.**

Explain it out loud, to yourself, to someone else, to your cat

and/or

write down a process to follow when working out problems of a certain type. Pretend you're explaining it to someone who doesn't know it.

Tip # 6: **Work all practice problems as completely as you can.**

Don't stop if you get a wrong answer to one and aren't sure where you went wrong, or if you notice the problems are getting more difficult. If you've gone over a problem several times and can't pinpoint your error, mark it and go on to the next one. Then come back to it. Or make a note to ask the instructor about it in the next class. When receiving an explanation, make sure you understand what the error was so you can avoid it in the future.

MATHEMATICS ON THE JOB I
SESSION 1

A PROCEDURE FOR SOLVING MATH PROBLEMS

Below is a general procedure to follow when solving math problems.

1. **Don't be afraid of the problem** (especially if it looks complicated). Go ahead. Give it your best shot. Even if you don't get the right answer, you'll learn a lot about the math process.

2. **Read the problem carefully.** Determine what you're given and what you're supposed to find.

3. **Refer to your process for solving the type of problem you're working on.** Follow the process, step by step. Be sure to be neat.

4. **Recheck your work.** (Neatness makes this easier.) Many students skip this step, but those that recheck learn more. (They see where they make their mistakes.) They also gain confidence more quickly. (They take the opportunity to learn from and correct their mistakes.)

5. **Ask yourself if the answer is reasonable.** Does it make sense, given the information you had to work with? Or does is seem way off? If it doesn't seem right, go back to Step 4, one more time.

Remember: You have the ability to learn and solve math problems. If you use the tips and techniques given in this module, you'll be on your way to math success.

CLEVELAND WOOD PRODUCTS

MATHEMATICS ON THE JOB I

OBJECTIVES

SESSION 2

- Read and write whole numbers
- Add and subtract whole numbers

MATHEMATICS ON THE JOB I
SESSION 2

READING AND WRITING WHOLE NUMBERS

Definitions

Digit

Decimal System

Place Value

Whole Number

MATHEMATICS ON THE JOB I
SESSION 2

READING AND WRITING WHOLE NUMBERS

What is a number?

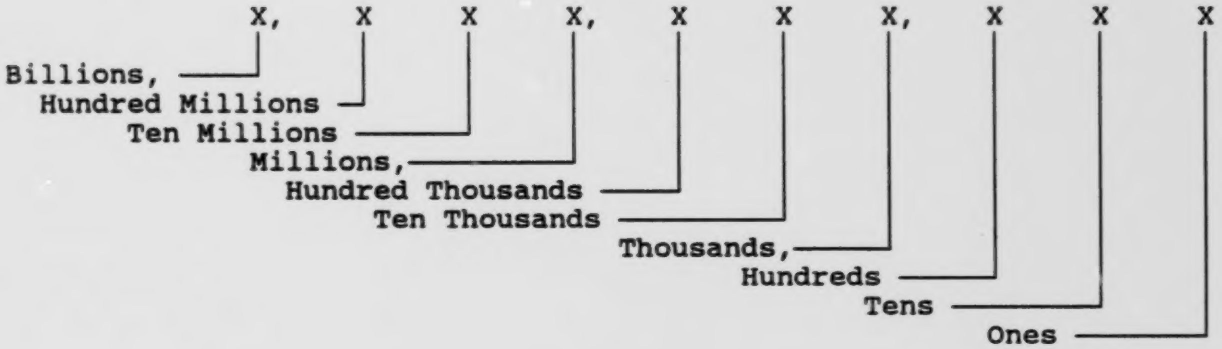
A number is an idea or picture of what's in someone's head. To express this idea to others, so they get the same picture, we use numerals.

How many dowels are shown below?

MATHEMATICS ON THE JOB I
SESSION 2

READING AND WRITING WHOLE NUMBERS

The Decimal System


X, X X X, X X X, X X X
Billions,
Hundred Millions
Ten Millions
Millions,
Hundred Thousands
Ten Thousands
Thousands,
Hundreds
Tens
Ones

6,827,439,012

means

______ billions,

______ hundred millions

______ ten millions

______ millions,

______ hundred thousands

______ ten thousands

______ thousands,

______ hundreds

______ tens

______ ones

MATHEMATICS ON THE JOB I
SESSION 2

READING AND WRITING WHOLE NUMBERS

Class Activity

Write out the following numbers:

1,756,843

320,472,082,126

MATHEMATICS ON THE JOB I
SESSION 2

Here are some clues to help you with writing numbers:

1. Whenever you hear one of the following words, you should immediately write a comma:

   thousand
   million
   billion

2. Each "group" of numbers after a comma __must__ have three digits. If you only hear two numbers, the missing one must be a zero.

   Zero is used as a place marker when there are no hundreds or tens or millions, for example. It's a very common error to leave out this zero.

PRACTICE

Are all the places accounted for in these numbers?

A. 24,31,295

B. 347,219,739

C. 1,856,23

D. 96,45,16

Did you notice that A, C, and D are wrong? To fix the incorrect numbers, put a zero immediately __after__ the comma if there are only two numbers in that group.

Rewrite the numbers correctly:

A. ______________________________

C. ______________________________

D. ______________________________

MATHEMATICS ON THE JOB I
SESSION 2

The instructor will say eight large numbers in groups of two. Each number will be repeated several times. Write down the numbers in numerical form.

A. ______________________________ **B.** ______________________________

A. ______________________________ **B.** ______________________________

A. ______________________________ **B.** ______________________________

A. ______________________________ **B.** ______________________________

MATHEMATICS ON THE JOB I
SESSION 2

READING AND WRITING WHOLE NUMBERS

Commas

Commas are used to help make numbers easier to read. Commas separate groups of 3 digits. Start at the end of the number, and count back: number number number COMMA; number number number COMMA.

Where would commas go in this number?

1 2 5 9 7 4

How about this number?

2 3 8 3 4 6 8 8

MATHEMATICS ON THE JOB I
SESSION 2

READING AND WRITING WHOLE NUMBERS

Practice

Write the following as whole numbers:

1. One hundred eighty-nine thousand six hundred forty eight

2. Fifty-seven thousand one hundred six

3. Three hundred fifty-two

4. Four hundred sixty-seven million, one hundred twenty thousand eight hundred fifteen

Put commas in the following numbers:

5. 3 4 5 6 9

6. 5 7 8 9 0 2 1

7. 4 3 2 9 3 4 1 5 6 6 3

ADDING AND SUBTRACTING WHOLE NUMBERS

Addition Definitions

Addends

Addition

Plus Sign (+)

Sum

MATHEMATICS ON THE JOB I
SESSION 2

ADDING AND SUBTRACTING WHOLE NUMBERS

Simple Addition Examples

$$\begin{array}{r} 8 \\ +\,3 \\ \hline 11 \end{array}$$

$7 + 5 = 12$

$4 + 2 = 6$

MATHEMATICS ON THE JOB I
SESSION 2

ADDING AND SUBTRACTING WHOLE NUMBERS

Class Activity

$$\begin{array}{r} 9 \\ +\ 1 \\ \hline \end{array} \qquad \begin{array}{r} 8 \\ +\ 4 \\ \hline \end{array} \qquad \begin{array}{r} 2 \\ +\ 6 \\ \hline \end{array} \qquad \begin{array}{r} 5 \\ +\ 4 \\ \hline \end{array}$$

$$\begin{array}{r} 7 \\ +\ 8 \\ \hline \end{array} \qquad \begin{array}{r} 6 \\ +\ 6 \\ \hline \end{array} \qquad \begin{array}{r} 4 \\ +\ 3 \\ \hline \end{array} \qquad \begin{array}{r} 5 \\ +\ 9 \\ \hline \end{array}$$

$$\begin{array}{r} 3 \\ +\ 1 \\ +\ 7 \\ \hline \end{array} \qquad \begin{array}{r} 2 \\ +\ 4 \\ +\ 6 \\ \hline \end{array} \qquad \begin{array}{r} 7 \\ +\ 2 \\ +\ 3 \\ \hline \end{array} \qquad \begin{array}{r} 8 \\ +\ 1 \\ +\ 2 \\ \hline \end{array}$$

$$\begin{array}{r} 5 \\ +\ 3 \\ +\ 7 \\ \hline \end{array} \qquad \begin{array}{r} 4 \\ +\ 5 \\ +\ 9 \\ \hline \end{array} \qquad \begin{array}{r} 3 \\ +\ 4 \\ +\ 6 \\ \hline \end{array} \qquad \begin{array}{r} 6 \\ +\ 1 \\ +\ 3 \\ \hline \end{array}$$

MATHEMATICS ON THE JOB I
SESSION 2

ADDING AND SUBTRACTING WHOLE NUMBERS

Adding Numbers with More Than One Digit

Example	Process
$$\begin{array}{r} 34 \\ +\ 63 \\ \hline 97 \end{array}$$	1. Arrange numbers in columns. 2. Add numbers in the Ones column. (Always start there.) 3. Add numbers in the Tens column.

Notes:

MATHEMATICS ON THE JOB I
SESSION 2

ADDING AND SUBTRACTING WHOLE NUMBERS

Carrying

Examples

$$\begin{array}{r} {}^{1}16 \\ +\ 28 \\ \hline 44 \end{array}$$

$$\begin{array}{r} {}^{1}33 \\ +\ 79 \\ \hline 112 \end{array}$$

Process

1. Arrange numbers in columns.
2. Add numbers in the Ones column.
3. If the addition of numbers in the Ones column yields a 2-digit result.

   a.) Write down the number of units under the Ones column.

   b.) Carry the number of Tens to the Tens column.

4. Add the numbers in the Tens column including the number you carried over.

Notes:

MATHEMATICS ON THE JOB I
SESSION 2

ADDING AND SUBTRACTING WHOLE NUMBERS

Class Activity

83 + 78	49 + 62	34 + 18
56 + 87	95 + 29	47 + 85

MATHEMATICS ON THE JOB I
SESSION 2

ADDING AND SUBTRACTING WHOLE NUMBERS

Class Activity

$$\begin{array}{r} 3{,}457 \\ 6{,}308 \\ +\ 1{,}232 \\ \hline \end{array} \qquad \begin{array}{r} 49{,}562 \\ 679 \\ +\ 8{,}516 \\ \hline \end{array}$$

$$\begin{array}{r} 17{,}022 \\ 4{,}656 \\ +\ \ 21{,}438 \\ \hline \end{array} \qquad \begin{array}{r} 856{,}917 \\ 2{,}125{,}487 \\ +\ 522{,}845 \\ \hline \end{array}$$

MATHEMATICS ON THE JOB I
SESSION 2

ADDING AND SUBTRACTING WHOLE NUMBERS

Addition Properties

Commutative Property of Addition

____

____

____

Example:

$2 + 3 + 4 = 9$
$3 + 4 + 2 = 9$
$4 + 3 + 2 = 9$
$3 + 2 + 4 = 9$
$2 + 4 + 3 = 9$
$4 + 2 + 3 = 9$

Associative Property of Addition

____

____

____

Example:

$9 + 4 + 2 + 1 + 6 = 22$
$(9 + 4) + (2 + 1) + 6 = 22$
$(9 + 4 + 2) + (1 + 6) = 22$
$9 + (4 + 2) + (1 + 6) = 22$

MATHEMATICS ON THE JOB I
SESSION 2

ADDING AND SUBTRACTING WHOLE NUMBERS

Class Activity

1. List all the ways you can think of to change the order of the numbers below according to the commutative property.

   $2 + 3 + 5$

2. Are the following mathematical statements true or false?

   a. $8 + 14 + 26 + 7 = 7 + 14 + 26 + 8$

   b. $7 + 2 + 5 = 7 + 5$

3. List 3 different ways to group the numbers below according to the associative property.

   $89 + 32 + 14 + 9$

4. Are the following mathematical statements true or false?

   a. $(3 + 4) + 2 = (3 + 4) + 3$

   b. $14 + (1 + 6) + (8 + 2 + 3) = (14 + 1) + 6 + 8 + (2 + 3)$

MATHEMATICS ON THE JOB I
SESSION 2

ADDING AND SUBTRACTING WHOLE NUMBERS

Subtraction Definitions

Difference

Minuend

Subtraction

Subtraction Sign (-)

Subtrahend

MATHEMATICS ON THE JOB I
SESSION 2

ADDING AND SUBTRACTING WHOLE NUMBERS

Class Activity

$$\begin{array}{r} 3 \\ +\ 2 \\ -\ 4 \\ +\ 1 \\ \hline \end{array} \qquad\qquad \begin{array}{r} 2 \\ -\ 2 \\ +\ 6 \\ -\ 3 \\ \hline \end{array}$$

$$\begin{array}{r} 8 \\ +\ 7 \\ -\ 3 \\ -\ 4 \\ \hline \end{array} \qquad\qquad \begin{array}{r} 5 \\ -\ 2 \\ -\ 1 \\ +\ 4 \\ \hline \end{array}$$

MATHEMATICS ON THE JOB I
SESSION 2

ADDING AND SUBTRACTING WHOLE NUMBERS

Subtracting Numbers with More Than One Digit

Example

$$\begin{array}{r} 385 \\ -\ 251 \\ \hline 134 \end{array}$$

Process

1. Arrange numbers in columns.
2. Subtract numbers in the Ones column. (Always start there.)
3. Subtract numbers in the Tens column.
4. Subtract numbers in the Hundreds column.

Notes:

MATHEMATICS ON THE JOB I
SESSION 2

ADDING AND SUBTRACTING WHOLE NUMBERS

Borrowing

Examples

$$\begin{array}{r} {}^{2}3\,{}^{1}5 \\ -\;1\;8 \\ \hline 1\;7 \end{array}$$

Tens

$$\begin{array}{r} {}^{2}3\,{}^{4}5\,{}^{1}6 \\ -\;1\;8\;9 \\ \hline 1\;6\;7 \end{array}$$

Process

1. Arrange numbers in columns.
2. Subtract numbers in the Ones column.
3. If the upper digit is smaller than the lower digit:
    a. Reduce the value of the digit in the column by 1.
    b. Add 10 to the digit in the Ones column.
4. Subtract the numbers in the Ones column using the borrowed value for the upper digit.
5. Subtract the numbers in the Tens column using the reduced value of the upper digit.

Notes:

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MATHEMATICS ON THE JOB I
SESSION 2

ADDING AND SUBTRACTING WHOLE NUMBERS

Class Activity

$$\begin{array}{r} 46 \\ -\ 29 \\ \hline \end{array} \qquad \begin{array}{r} 513 \\ -\ 225 \\ \hline \end{array} \qquad \begin{array}{r} 87 \\ -\ 58 \\ \hline \end{array}$$

$$\begin{array}{r} 222 \\ -\ 57 \\ \hline \end{array} \qquad \begin{array}{r} 4{,}672 \\ -\ 2{,}584 \\ \hline \end{array}$$

MATHEMATICS ON THE JOB I
SESSION 2

THE ANSWER IS RIGHT!

Problem Sheet

$$\begin{array}{r} 35 \\ +\ 47 \\ \hline \end{array} \qquad \begin{array}{r} 637 \\ -\ 256 \\ \hline \end{array} \qquad \begin{array}{r} 90{,}972 \\ +\ 1{,}756 \\ \hline \end{array}$$

$$\begin{array}{r} 906 \\ -\ 81 \\ \hline \end{array} \qquad \begin{array}{r} 42 \\ 120 \\ +\ 53 \\ \hline \end{array} \qquad \begin{array}{r} 102{,}345 \\ +\ 453{,}197 \\ \hline \end{array}$$

$$\begin{array}{r} 1{,}178 \\ -\ 645 \\ \hline \end{array} \qquad \begin{array}{r} 580 \\ -\ 14 \\ \hline \end{array} \qquad \begin{array}{r} 13 \\ +\ 1{,}345 \\ \hline \end{array}$$

CLEVELAND WOOD PRODUCTS

MATHEMATICS ON THE JOB I

OBJECTIVES

SESSION 3

- Demonstrate the ability to solve word problems involving addition and subtraction of whole numbers on job-related materials.
- Multiply and divide whole numbers.

MATHEMATICS ON THE JOB I
SESSION 3

SOLVING ADDITION AND SUBTRACTION WORD PROBLEMS

Five Steps to Solving Word Problems

1. Determine what the question is.

2. Eliminate any extra information given in the problem.

3. Identify what mathematical operation or operations to use.

4. Perform the math to solve the problem. Write down your answer and check your work.

5. Ask yourself if your answer is reasonable.

MATHEMATICS ON THE JOB I
SESSION 3

SOLVING ADDITION AND SUBTRACTION WORD PROBLEMS

Example Word Problem

Gary produced 512 Douglas rings today and 482 Douglas rings yesterday. The boring machine was down both days. How many Douglas rings did he produce all together for both days?

Step 1. The question is:

Step 2. The extra information is:

Step 3. The math operation I'll use to solve the problem is:

Step 4. The math:

Step 5. Is my answer reasonable?

MATHEMATICS ON THE JOB I
SESSION 3

SOLVING ADDITION AND SUBTRACTION WORD PROBLEMS

Addition Key Words

Sum

And

Plus

Add

Total

Increase

More

Raise

Both

Combined

In all

All together

Additional

Extra

MATHEMATICS ON THE JOB I
SESSION 3

SOLVING ADDITION AND SUBTRACTION WORD PROBLEMS

Addition Word Problem

Maria, who's been with the company for 15 years, increased her average production by 200 pieces per week. Her previous production was 1800 pieces per week. How many pieces per week does she produce now?

Step 1: ____

____

____

Step 2: ____

____

____

Step 3: ____

____

____

Step 4: ____

____

____

Step 5: ____

____

____

MATHEMATICS ON THE JOB I
SESSION 3

SOLVING ADDITION AND SUBTRACTION WORD PROBLEMS

Subtraction Key Words

Less than
More than
Decrease
Difference
Reduce
Lost
Nearer

Farther
Left
Remain
Fell
Dropped
Change
Fewer

MATHEMATICS ON THE JOB I
SESSION 3

SOLVING ADDITION AND SUBTRACTION WORD PROBLEMS

Subtraction Word Problem

Gary isn't feeling well and his production is down from its normal level. He produced 512 brushes today and 482 brushes yesterday. How many fewer brushes did he produce yesterday than today?

Step 1: ______________________________

____

____

Step 2: ______________________________

____

____

Step 3: ______________________________

____

____

Step 4: ______________________________

____

____

Step 5: ______________________________

____

____

MATHEMATICS ON THE JOB I
SESSION 3

SOLVING ADDITION AND SUBTRACTION WORD PROBLEMS

Warning: Be careful with key words

Example

Maria increased production on her center boring machine to 200 dowels per week. She's now producing 1800 dowels per week, and got a $500 bonus for being such a productive worker. How many dowels per week was she producing before?

Step 1:

Step 2:

Step 3:

Step 4:

Step 5:

MATHEMATICS ON THE JOB I
SESSION 3

SOLVING ADDITION AND SUBTRACTION WORD PROBLEMS

Additional Strategies for Solving Word Problems

1. Restate the problem in your own words.

____

____

____

____

2. Draw pictures or diagrams.

____

____

____

____

3. Write number sentences.

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____

____

____

MATHEMATICS ON THE JOB I
SESSION 3

SOLVING ADDITION AND SUBTRACTION WORD PROBLEMS

Example: Restating the Problem

John Smith is filling out a rework and scrap report for rug renovator brushes. 19 pieces were reworked this week due to missing tufts. On Monday, there were 4 reworked parts, on Tuesday 7 and on Thursday 2. John has been training a new person, and didn't get his afternoon break all week. How many pieces were reworked on Friday?

Step 1: ______________________________

____

____

Step 2: ______________________________

____

____

Step 3: ______________________________

____

____

Step 4: ______________________________

____

____

Step 5: ______________________________

____

____

MATHEMATICS ON THE JOB I
SESSION 3

SOLVING ADDITION AND SUBTRACTION WORD PROBLEMS

Example: Draw Pictures or Diagrams

Bob produced 572 dowels on Wednesday. Of the total, 465 were good parts. How many rejects were there?

Step 1: ______________________________

Step 2: ______________________________

Step 3: ______________________________

Step 4: ______________________________

Step 5: ______________________________

MATHEMATICS ON THE JOB I
SESSION 3

SOLVING ADDITION AND SUBTRACTION WORD PROBLEMS

Example: Number Sentences

Sam worked 10 hours on Tuesday, 9 hours on Wednesday, and 11 hours on Thursday. Last week, Sam called in sick 4 days. How many total hours did he work over the 3 days?

Step 1: ________________________________

____

____

Step 2: ________________________________

____

____

Step 3: ________________________________

____

____

Step 4: ________________________________

____

____

Step 5: ________________________________

____

____

MATHEMATICS ON THE JOB I
SESSION 3

SOLVING ADDITION AND SUBTRACTION WORD PROBLEMS

PRACTICE

1. John worked 8 hours on Monday, 7 hours on Tuesday, 12 hours on Wednesday, 10 hours on Thursday, and 12 hours on Friday. How many hours did he work during this week?

2. An automatic machine requires servicing after every 300 hours of operation. If the operating-time indicator now reads 193 hours, how many hours remain before the next service is required?

3. A water pipe leaked 15 gallons the first hour, 17 gallons the second hour, and 19 gallons the third hour. How many gallons of water have been lost in three hours?

4. The perimeter of a triangle is found by adding together the lengths of each of its sides. If a triangle has sides measuring 14 inches, 9 inches, and 17 inches, what is the perimeter of the triangle?

5. A container holds brushroll assemblies. The total weight of the container and brushroll assemblies is 202 kg; the container weighs 58 kg. How much do the brushroll assemblies weigh?

6. There are 61 tons of coal in a coal pile. 20 tons of coal were burned in the factory today and 18 tons of coal were burned yesterday. How many tons of coal remain in the coal pile?

7. The Kirby Company ordered $38,934 worth of brushroll assemblies. Regina Dirt Devil ordered $96,725 of brushroll assemblies. How much more did Regina order than Kirby?

MATHEMATICS ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Multiplication Definitions

Multiplicand

Multiplication

Multiplication Sign (x)

Multiplier

Product

Partial Product

MATHEMATICS ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Multiplication Table

X	1	2	3	4	5	6	7	8	9
1	1	2	3	4	5	6	7	8	9
2	2	4	6	8	10	12	14	16	18
3	3	6	9	12	15	18	21	24	27
4	4	8	12	16	20	24	28	32	36
5	5	10	15	20	25	30	35	40	45
6	6	12	18	24	30	36	42	48	54
7	7	14	21	28	35	42	49	56	63
8	8	16	24	32	40	48	56	64	72
9	9	18	27	36	45	54	63	72	81

MATHEMATICS ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Class Activity

3 x 4 =

2 x 4 =

9 x 6 =

5 x 8 =

6 x 6 =

7 x 3 =

7 x 9 =

8 x 3 =

4 x 7 =

3 x 5 =

9 x 9 =

2 x 6 =

MATHEMATICS ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

The Multiplication Process

Examples **Process**

1. Arrange numbers in columns.

$$\begin{array}{r} {}^{3}25 \\ \underline{\times 16} \\ {}^{1}150 \\ \underline{25} \\ 400 \end{array}$$

2. Multiply the top number by the Ones place digit of the bottom number.
   a. First, multiply the Ones place digit of the top number by the Ones place digit of the bottom number. Write down the Ones place digit of the product in the Ones column. Carry the 10's place digit.
   b. Next, multiply the 10's place digit of the top number by the Ones place digit of the bottom number.
   c. Then, add the number you carried to this product. Write the number down next to the number in the Ones column.

   This is the first partial product.

$$\begin{array}{r} {}^{32}79 \\ \underline{\times 43} \\ 237 \\ \underline{316} \\ 3397 \end{array}$$

3. Multiply the top number by the Tens place digit of the bottom number.
   a. First, multiply the Ones place digit of the top number by the Tens place digit of the bottom number. Write down the Ones place digit of the product in the Tens column. Carry the Tens place digit.
   b. Next, multiply the Tens place digit of the top number by the Tens place digit of the bottom number.
   c. Then, add the number you carried to this product. Write the number down next to the number in the Tens column.

   This is the second partial product.

4. Add the partial products together.

IMPORTANT: Make sure the numbers are lined up correctly.

This is the final product of the two numbers.

MATHEMATICS ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Multiplication Properties

Commutative Property of Multiplication

Example: $4 \times 5 = 20$
$5 \times 4 = 20$

Associative Property of Multiplication

Example: $2 \times (4 \times 5) = 40$
$(2 \times 4) \times 5 = 40$

MATHEMATICS ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Class Activity

26	87	99	29
x 15	x 25	x 46	x 73

122	347	875
x 18	x 84	x 36

Are the following mathematical statements true or false?

3 x 4 x 2 = 2 x 3 x 4

(1 x 9) x 6 = 9 x 1

48 x (3 x 20) = (20 x 3) x 48

MATHEMATICS ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Division Definitions

Dividend ______________________________

____

____

Division ______________________________

____

____

Division Sign (÷) ______________________________

____

____

Divisor ______________________________

____

____

Quotient ______________________________

____

____

Remainder ______________________________

____

____

MATHEMATICS ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Class Activity

64 ÷ 8 =

72 ÷ 9 =

90 / 9 =

40 / 8 =

63 / 7 =

24 ÷ 4 =

30 ÷ 5 =

42 / 6 =

18 / 6 =

56 / 8 =

MATHEMATICS ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Long Division

Examples

$$\begin{array}{r} 80 \\ 21\overline{)1692} \\ -168 \\ \hline 12 \\ -0 \\ \hline 12 \end{array}$$

$$\begin{array}{r} 183 \\ 14\overline{)2564} \\ -14 \\ \hline 116 \\ -112 \\ \hline 44 \\ -42 \\ \hline 2 \end{array}$$

Process

1. Place dividend under division box. Place divisor to the left of division box.
2. Determine the number of digits in the dividend to divide the divisor into.

   a. First, try dividing the divisor into the same number of digits in the dividend.
   b. If that number of digits makes a number that's too small, add one more digit to the dividend.
3. Divide the divisor into the number of digits you determined in Step 2. Write the quotient above the last number of these digits.
4. Test your answer by multiplying the quotient by the divisor and subtracting the product from the partial dividend. If the difference is not negative and is less than the divisor, your quotient is correct. Move on to Step 5.

   a. If your difference is negative, repeat Steps 3 and 4 with a quotient that is less than your original guess.
   b. If your difference is more than your divisor, repeat Steps 3 and 4 with a quotient that is larger than your original guess.
5. Bring down the next digit in the dividend, writing it next to the difference your found in Step 4.

MATHEMATICS ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Long Division

6. Divide the divisor into the new dividend. Write this digit of your quotient to the right of the first digit of the quotient.

7. Test your answer by multiplying the second digit of the quotient by the divisor and subtracting the product from the new partial dividend. If the difference is not negative and is less than the divisor, the second digit of your quotient is correct. Move on to Step 8.
    a.) If your difference is negative, repeat Steps 3 and 4 with a quotient that is less than your original guess.
    b.) If your difference is more than your divisor, repeat Steps 3 and 4 with a quotient that is larger than your original guess.
8. You would continue the process of bringing down digits, dividing, and testing the quotient until the last digit in the dividend has been brought down and tested. When you've found the last digit in the quotient, you're done! Any amount left over when you subtract is called the remainder.
9. Check your answer by multiplying the divisor by the quotient and then, adding the remainder. You should come up with the dividend.

MATHEMATICS ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Class Activity

4318 ÷ 7 =   6781 ÷ 4 =

$18\overline{)2632}$ $36\overline{)44,219}$

APPENDIX

CHAPTER 3 - ADDITIONAL WORD PROBLEMS

Solve each of the following word problems.

1. One bid for repairing the center boring machine was $1,954. A second bid was $1,742. How much would be saved using the second bid?

2. Rudy Tafoya earns $25,000 per year. He had $1,523 withheld from his paycheck last year for income tax, but he owes only $1,379 in tax. What refund should he receive?

3. CWP now pays $439 per month for their supply of tufts. If they double their order, the payment will be $702 per month. How much extra will they pay each month?

4. A forklift truck now goes 374 miles on a tank of gas. After a tune-up, the same forklift will go 401 miles on a tank of gas. How many additional miles will it go after the tune-up?

5. At People's Bank, Cleveland Wood Products can earn $14,608 per year in interest, while Farmer's Bank would pay $15,543 interest. How much additional interest would CWP earn at the second bank in one year?

APPENDIX

CHAPTER 3 - ADDITIONAL WORD PROBLEMS

A salesman and his manager need to travel from Washington to Denver to visit a major client. Approximate one-way costs for two adults are listed below. Find the total cost for each form of transportation.

WASHINGTON TO DENVER

Airplane (4 hours one way)	
Coach Fare	$944
Meals	No Charge

Bus (44 hours one way)	
Fare	$614
Meals	68

Train (42 hours one way)	
Coach Fare	$492
Meals	98

Automobile (72 hours one way)	
Gasoline and Maintenance	$905
Tolls	6
Meals	174
Lodging	136

1. How much money could the company save if the men travelled round trip by bus rather than by automobile?

2. How much time could the salesmen save if they travelled round trip by bus rather than by automobile?

3. How much money could the company save if the men travelled round-trip by train rather than plane?

4. How much longer would a round-trip take by car compared to a plane?

CLEVELAND WOOD PRODUCTS

MATHEMATICS ON THE JOB I

OBJECTIVES

SESSION 4

- Introduction to calculators.
- Demonstrate the ability to solve word problems involving multiplication and division of whole numbers on job-related materials.

MATHEMATICS ON THE JOB I
SESSION 4

INTRODUCTION TO CALCULATORS

Introduction

Calculators are among the most popular inventions of recent years. Calculators constantly become more powerful, and cheaper; today's calculators perform calculations that could previously be done only by mainframe computers. There are many models of calculators, made by a wide variety of companies, but most operate in a very similar manner.

The problem 9 + 8 would be entered as

9 + 8 =

and 17 would appear as the answer. Enter 17 - 8 as

17 - 8 =

and 9 appears as the answer.

When entering large numbers, do not try to enter a comma. However, **if the number has a decimal point** (as in dollars and cents), **be sure the press the period key at the appropriate place in the number**. Sometimes, when doing a problem with dollars and/or decimals, the calculator will show just one number after the decimal point, for example:

97.5

If there is just one number after the decimal point and you need dollars and cents, just add a zero at the end of the answer. The answer above would represent $97.50.

Introduction (Cont'd)

All calculators have a **C** key. **This key erases everything in the calculator and prepares the calculator to begin a new problem.**

Some calculators also have a **CE** key. **Pressing this key erases only the number showing on the display screen** and allows the person using the calculator to correct a mistake without having to start the problem over.

Some calculators have a combination **C/CE** key. In this case, **pressing the key once will erase the entry just made,** and **pressing it twice will clear out the calculator and get it ready for the next problem.**

For the rest of this course, there will be some problems for you to work without calculators, and some (harder) problems for you to try with a calculator.

Try entering these problems into your calculator, and see if you get the right answer. **If you get confused, press the C/CE key twice and try again.**

MATHEMATICS ON THE JOB I
SESSION 4

CALCULATOR PRACTICE

511	324	$ 3.58	$ 3,299.99
23	7,855	249.63	141.00
154	23	7.03	25.36
+ 10	+ 86	+ .09	+ .95

Did you remember to add a zero at the end of the last answer? The problem is with dollars and cents, so the .3 actually meant 30 cents.

Now try these:

9,431	7,000	587	9,742
- 210	- 4,999	- 342	- 8,131

$ 4,271.35	57	3,214	
372.54	4	762	11,746
8,976.76	392	936	21,892
+ 162.05	+ 162	+ 8,325	+ 43,925

6,259	46,253	9,988	75,904
- 4,148	- 5,123	- 677	- 3,702

MATHEMATICS ON THE JOB I
SESSION 4

SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

A Review of the 5-Step Process

Step 1. What is the question?

Step 2. What is the extra information?

Step 3. What mathematical operation(s) will I use to arrive at the answer?

Step 4. Do the math. (Be sure to check your work.)

Step 5. Ask yourself "Is my answer reasonable?"

MATHEMATICS ON THE JOB I
SESSION 4

SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

Multiplication Word Problems

Example

Nancy painted 413 dowels every day for 5 days. How many dowels did she paint this week?

Step 1:

Step 2:

Step 3:

Step 4:

Step 5:

MATHEMATICS ON THE JOB I
SESSION 4

SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

Multiplication Key Words

Multiplied

Times

Total

Of

Per

As Much

Twice

By

Area

Volume

MATHEMATICS ON THE JOB I
SESSION 4

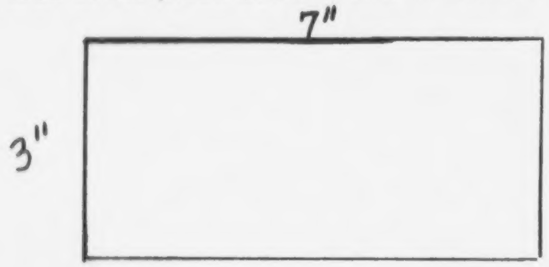
SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

Areas

To find the area of a square or rectangle, you multiply the length times the width. Area is expressed in square units.

Examples: square inches, square feet

What is the area of the piece of metal shown below?



Step 1: ______________________________

____

Step 2: ______________________________

____

Step 3: ______________________________

____

Step 4: ______________________________

____

Step 5: ______________________________

____

MATHEMATICS ON THE JOB I
SESSION 4

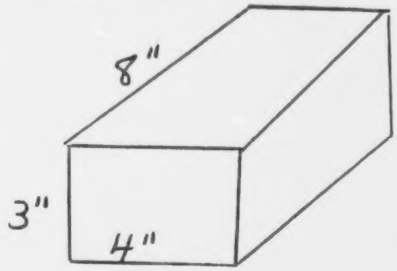
SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

Volumes

To find the volume of a rectangle, you multiply the length times the width times the height. Volume is expressed in cubic units.

Examples: cubic inches, cubic feet

What is the volume of the box shown below?



Step 1: ______________________________

____

Step 2: ______________________________

____

Step 3: ______________________________

____

Step 4: ______________________________

____

Step 5: ______________________________

____

MATHEMATICS ON THE JOB I
SESSION 4

SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

Division Word Problems

Example

Gary has to pack 575 dowels in boxes that hold 25 dowels each. There are 2 skids of boxes near his work area. How many boxes will he need?

Step 1: ________________

Step 2: ________________

Step 3: ________________

Step 4: ________________

Step 5: ________________

MATHEMATICS ON THE JOB I
SESSION 4

SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

Division Key Words

Divided

Split

Each

Cut

Equal pieces

Average

Every

Out of

Ratio

Shared

MATHEMATICS ON THE JOB I
SESSION 4

SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

Averages

Sam bored 9,840 dowels for the month of October. He worked 20 days during the month and left early 3 times. What was his average daily production?

Step 1: ____

____

____

Step 2: ____

____

____

Step 3: ____

____

____

Step 4: ____

____

____

Step 5: ____

____

____

MATHEMATICS ON THE JOB I
SESSION 4

SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

The Total-Part Method

5 machines each produce 74 dirt magnets per hour. How many dirt magnets can all 5 machines produce in 6 hours?

TOTAL = ?

5 MACHINES (PART)

74 DIRT MAGNETS PER HOUR (PART)

6 HOURS (PART)

Step 1: ______________________________

Step 2: ______________________________

Step 3: ______________________________

Step 4: ______________________________

Step 5: ______________________________

MATHEMATICS ON THE JOB I
SESSION 4

SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

The Total-Part Method

5 machines each bore 74 dowels per hour. How many hours would all 5 machines need to run to bore 3,330 dowels?

3,300 DOWELS
TOTAL

5 MACHINES
(PART)

74 DOWELS PER
HOUR (PART)

? HOURS
(PART)

Step 1:

Step 2:

Step 3:

Step 4:

Step 5:

MATHEMATICS ON THE JOB I
SESSION 4

SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

Word Problems Involving More Than One Operation

Sheila's machine makes 3 brushroll assemblies per minute. Inspection can inspect 100 assemblies per hour. The paint department can paint 50 dowels each hour. How many assemblies will be waiting for inspection at the end of 2 hours, assuming Sheila continues working at the same pace?

Step 1: ______________________________

____

____

Step 2: ______________________________

____

____

Step 3: ______________________________

____

Step 4: ______________________________

____

Step 5: ______________________________

____

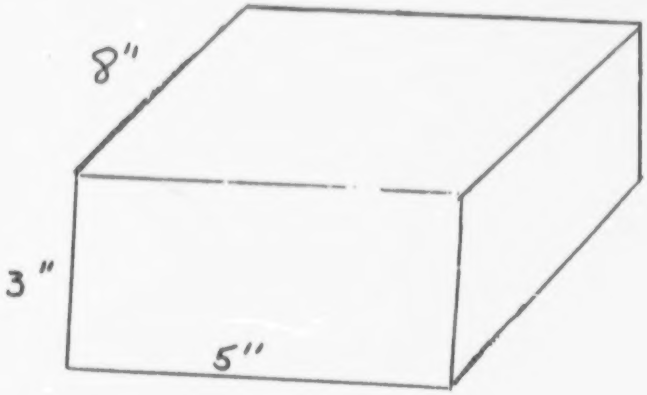
MATHEMATICS ON THE JOB I
SESSION 4

SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

PRACTICE

1. 5 packers ship 20,000 side kick brush assemblies per day. If each packer loads 25 shipping cartons per day, how many brush assemblies are in a shipping carton?

2. What is the volume of the piece of metal shown below?



3. The Kirby cell measures 2 pieces every 2 hours. They get 2 15-minute breaks each shift. How many pieces do they measure each 8-hour shift?

4. A single automated paint shift produces 4,000 dowels per shift. If each shift runs 8 hours, how many shifts will it take to paint an order of 24,000 dowels?

5. The number of reworked Regina dirt magnets during a week is listed below. Give the range of reworked magnets, and then find the average number of parts needing rework each day.

Monday: 4 Tuesday: 6 Wednesday: 35
Thursday: 0 Friday: 15

APPENDIX

CHAPTER 4 -- ADDITIONAL WORD PROBLEMS

1. Maria works overtime each week; she is paid time and a half for any hours over 40 each week. Her hourly wage is 14.80. In November last year, Maria worked 40 hours the first week, 55 hours the second week, 45 hours the third week, and 41 hours the last week. How much did Maria earn in November? (before taxes or other deductions were taken out of her check).

2. Joe Stefanopoulos earns $13.64 an hour, and time and a half for any hours over 40 per week. Below is his time sheet for March. How much did he earn in overtime pay?

First week, March	53 hours
Second week, March	52 hours
Third week, March	40 hours
Fourth week, March	62 hours

3. You accrue sick time at the rate of 1 day every 3 months. At the end of 2 years, assuming you have never called in sick, how much sick time have you accrued? You have just gotten a raise and earn $16.25 per hour.

CHAPTER 4 -- ADDITIONAL WORD PROBLEMS

4. Anita Harris earns 1 day of sick leave for every month she works after her initial 3-month probation. She also earns 1 day of vacation per month, beginning from her first day of employment. At the end of a year and a half, assuming she has not called in sick, how much sick time has she accrued?

5. Julio Gomez likes to work overtime because he earns time and a half for every hour over 44 hours per week. His regular rate of pay is $9.50 per hour. The first week of last month he worked 44 hours, the second week 45 hours, the third week 50 hours, the fourth week 48 hours. So far this month, he worked 55 hours the first week and 60 hours the second week. How much did Julio earn last month (before taxes or other deductions were taken out of his check)?

6. The paint machine must be serviced after every 200 hours of operation. If the machine can paint 375 dowels per hour, how many dowels will be painted between each service call?

CHAPTER 4 -- ADDITIONAL WORD PROBLEMS

7. Because the service calls for routine maintenance on the center boring machines are getting very expensive, CWP has requested bids from different companies to do the work. Three bids were obtained. The current servicer (Acme Company) charges $500 for a three-month contract, plus a $75 charge per call. (There are normally 2 calls per month.) Beta Company charges a flat $1,000 for a three-month contract, and all service calls are included. Capstone Company charges only on a per-call basis, at the rate of $375 per call. Capstone is a sister company to CWP. Which company would be the cheapest for the three months?

8. CWP works 8-hour shifts, and closes for the week between Christmas and New Year's. Generally, there are some workers on layoff who could be called in to cover for absent employees. On Tuesday, 4 workers called in sick, and no replacements could be found. How many man-hours were lost?

9. The boring machine appeared to be misfeeding quite a bit this week. The serviceman was called out 3 times, and said the machine was fine. However, there were lots of rejects due to this machine: 40 dowels Monday, 35 Tuesday, 27 Wednesday, 15 Thursday, and 47 Friday. If this continues for 3 weeks, how many rejected dowels will there be?

CHAPTER 4 – ADDITIONAL WORD PROBLEMS

10. The Kirby cell is packing boxes for an order which needs to be shipped today. If each box can hold 14 brushroll assemblies along the short side, and 25 along the longer side, how many brushroll assemblies can be packed in each box?

11. The Regina Company ordered 3,825 dirt magnets. They were shipped 137 boxes of 3 dozen magnets each. Did Regina receive the right number of dirt magnets? If not, were they over or short, and by how much?

12. Philip DiSantis is being trained on the use of the center boring machine, and is having trouble seating the dowels properly. The number of rejects for his first week is as follows: Monday: 25; Tuesday: 38; Wednesday: 41; Thursday, 43; Friday: 49. What is the range of rejects? What is the average? What is the total?

CLEVELAND WOOD PRODUCTS

MATHEMATICS ON THE JOB I

OBJECTIVES

SESSION 5

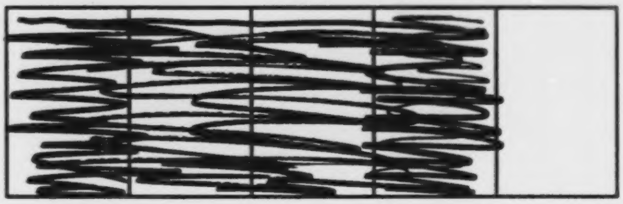
- Introduction to fractions.
- Demonstrate the ability to convert fractions to decimals.
- Demonstrate the ability to correctly read rulers and gages.

MATH ON THE JOB I
SESSION 5

Fractions and Decimals

What is a Fraction?

A fraction is a number whose value is between 0 and 1. A fraction tells you that a whole number has been divided into 2 or more equal parts and that you have a certain number of those parts. For instance, consider the rectangle below:



How many parts is it divided into? ______________

How many parts are shaded? ______________

Write a fraction to represent the shaded portion. ______________

MATH ON THE JOB I
SESSION 5

Fractions Definitions

Denominator

Numerator

Comparing Fractions

Which fraction is larger?

3/16 7/16

Why?

Which fraction is larger?

1/3 1/6

Why?

MATH ON THE JOB I
SESSION 5

Practice

Which Fraction is Bigger?

$$\frac{2}{7} \qquad \frac{2}{5} \qquad\qquad\qquad \frac{15}{30} \qquad \frac{15}{26}$$

$$\frac{10}{12} \qquad \frac{6}{12} \qquad\qquad\qquad \frac{3}{5} \qquad \frac{4}{5}$$

$$\frac{1}{10} \qquad \frac{1}{9} \qquad\qquad\qquad \frac{97}{100} \qquad \frac{95}{100}$$

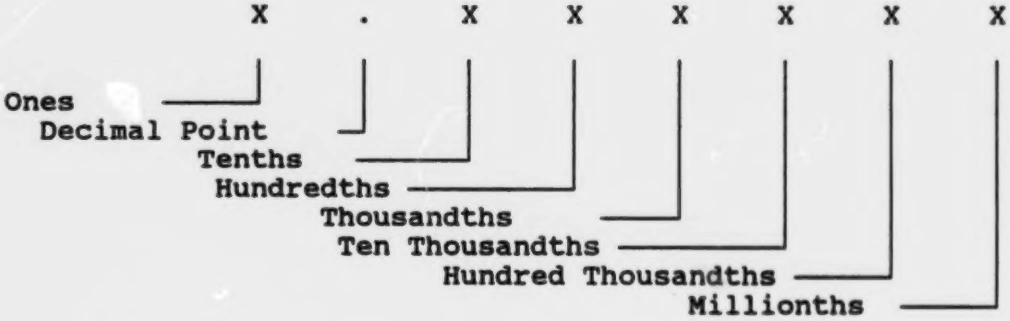
$$\frac{42}{70} \qquad \frac{45}{70} \qquad\qquad\qquad \frac{7}{9} \qquad \frac{4}{9}$$

$$\frac{3}{4} \qquad \frac{6}{4} \qquad\qquad\qquad \frac{13}{26} \qquad \frac{15}{26}$$

MATH ON THE JOB I
SESSION 5

Decimals

A decimal is a fraction that has a denominator that is a multiple of 10. However, in writing decimals, the denominator is indicated by place value. The place values of numerals to the left of the decimal point are shown below:


X . X X X X X X
Ones
Decimal Point
Tenths
Hundredths
Thousandths
Ten Thousandths
Hundred Thousandths
Millionths

What are the values of the following decimals?

.4 ____________

.04 ____________

.004 ____________

.0004 ____________

.00004 ____________

.000004 ____________

MATH ON THE JOB I
SESSION 5

Decimal Definitions

Decimal Point (.) ____

____

____

Place ____

____

____

many decimal places are in each of the following numbers?

32.46 ______

5.7638 ______

191.1 ______

20.00 ______

MATH ON THE JOB I
SESSION 5

H. 10,198.95314 ________________

I. 25,377.91083 ________________

J. 1.00314 ________________

Converting Fractions to Decimals

To convert a fraction to a decimal, simply divide the denominator into the numerator and carry out the division to the desired number of decimal places.

Examples: To change 3/4 to a decimal, divide 4 into 3.

```
    .75
 4|3.00
  - 2 8
   ---
     20
   - 20
    ---
      0
```

Change 25/32 to a decimal. Round to 4 decimal places.

```
    .7812
 32|25.000
   - 22 4
   ------
      2 60
    - 2 56
    ------
        40
      - 32
       ---
        80
        64
      ----
        16
```

MATH ON THE JOB I
SESSION 5

Practice

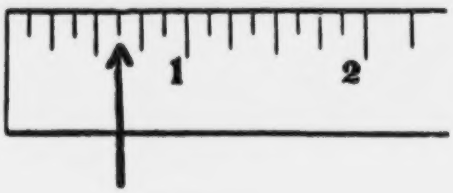
	Fraction	Decimal Equivalent		Fraction	Decimal Equivalent
A.	$\frac{4}{5}$		J.	$\frac{7}{8}$	
B.	$\frac{97}{129}$		K.	$\frac{5}{6}$	
C.	$\frac{36}{74}$		L.	$\frac{24}{97}$	
D.	$\frac{76}{140}$		M.	$\frac{17}{39}$	
E.	$\frac{1}{4}$		N.	$\frac{41}{109}$	
F.	$\frac{2}{3}$		O.	$\frac{2}{4}$	
G.	$\frac{1}{3}$		P.	$\frac{3}{8}$	
H.	$\frac{111}{297}$		Q.	$\frac{4}{9}$	
I.	$\frac{47}{86}$		R.	$\frac{5}{12}$	

MATH ON THE JOB I
SESSION 5

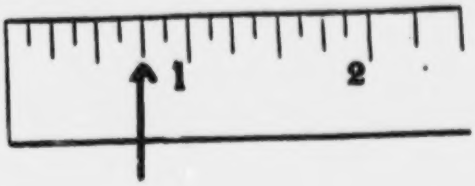
Reading Rulers and Gages

Rulers and gages divide large units of whole numbers into their fractional parts. Look at the ruler below. There are eight sections between the end of the ruler and the one inch line. Each of these sections is 1/8 of an inch. Notice that there are some longer lines and some shorter lines. How many spaces are between the longer lines? Did you count 4? Yes; that means that each section between the longer lines is 1/4th of an inch.

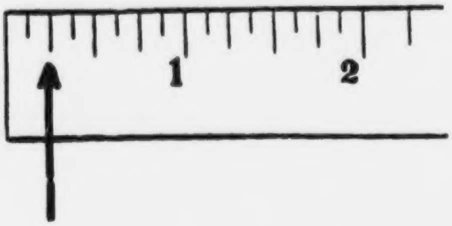
What is the measurement shown on each ruler below?



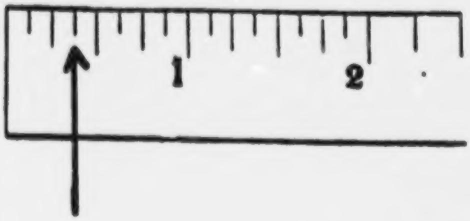
______



______



______



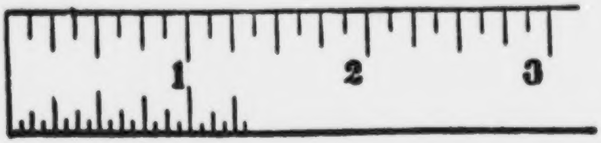
______

Most rulers and gages, however, have even more subdivisions than fourths and eighths. You can use the same process to read them: count how many spaces are between lines of the same length.

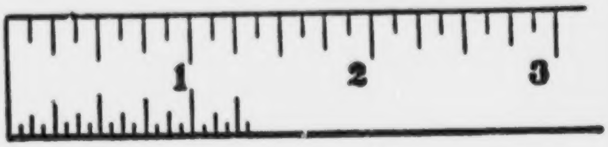
MATH ON THE JOB I
SESSION 5

Mark each of the rulers below with an arrow at the indicated measurement.

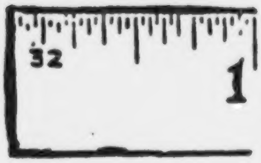
13/16



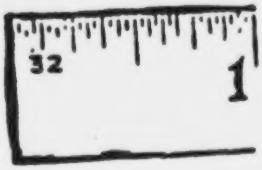
12/16



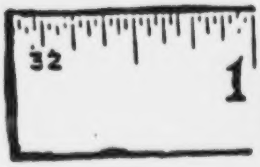
7/32



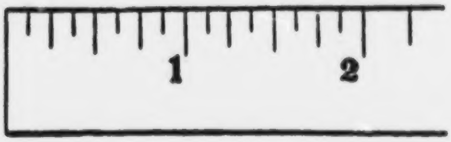
16/32



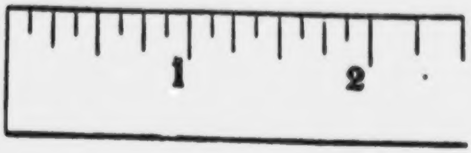
1/32



7/8



3/8



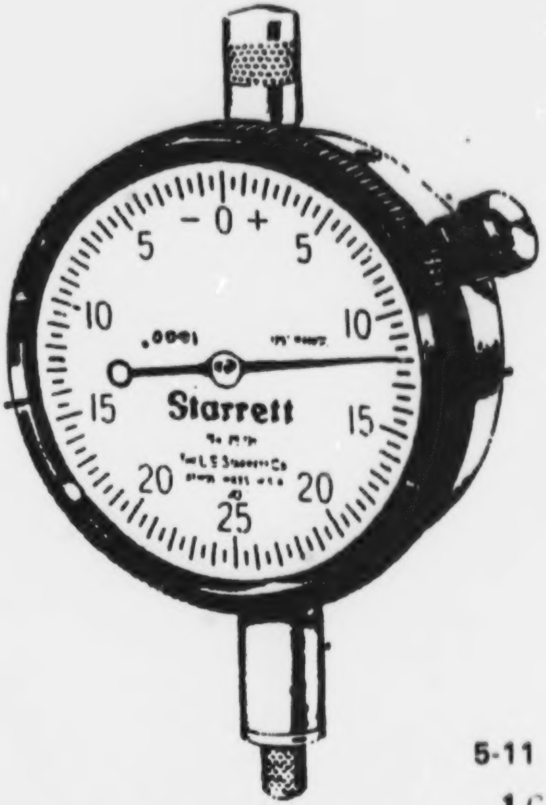
MATH ON THE JOB I
SESSION 5

Reading Gages

There are many different types of gages in use, but all share some common characteristics:

- Generally, only **some** intervals are labeled. For example, in the gage shown below, only 5, 10, 15, etc. are labeled. In order to figure out the markings in between the numbers, start with the longer lines. Try counting longer lines and see if you reach the number shown next, without any longer lines left over. For example, there are 10 spaces between 0 and 5 on the gage below, so it is easy to see that the short line is 1/2, and the longer line is the whole number. In other words, to count the spaces on this gage, you need to count: 1/2, 1, 1 1/2, 2, 2 1/2, 3, 3 1/2, etc. That method of counting will take you to 5 with no lines left over.

- **This gage has both positive and negative markings.** The numbers are the same, but those on the left hand of the dial are negative numbers (see the negative sign to the left of 0). Those on the right side of the dial are positive numbers. (The + is on the right of the 0.)



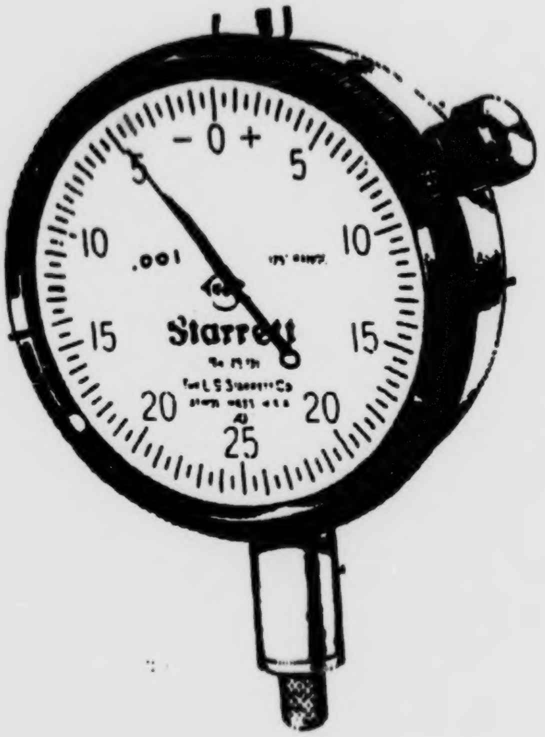
- Gages generally have a "code" on the face which tells how to read the numbers. For example, on the gage shown here, **the "code" is .0001.** That means, you must put a decimal point at the beginning, and the number the needle points to at the end, and fill in the middle with zeroes. The number is read out loud as a fraction, for example: 1/10,000ths.

The gage shown is indicating a reading of 12. It is written ".0012", and is verbally read as 12/10,000ths.

MATH ON THE JOB I
SESSION 5

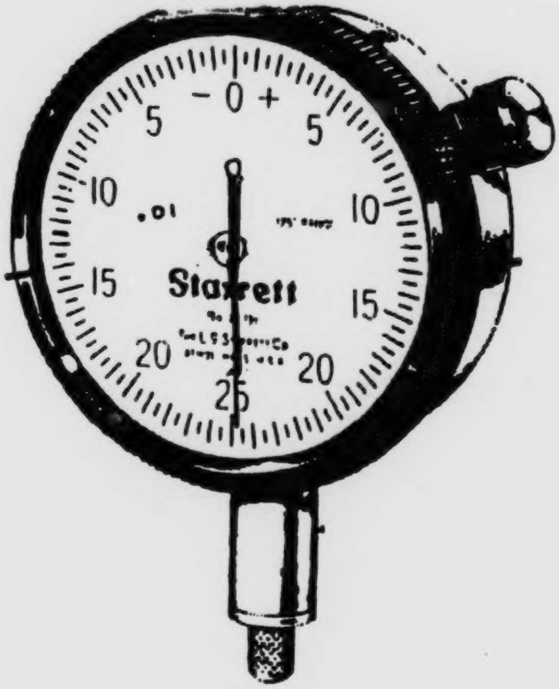
Be careful as you do the practice exercises here: each gage can have a different "code" for how to read the numbers.

For the gages shown below, write the number the needle is pointing to, and then write how the number would be read, using both the decimal and fraction forms. See the example:


- 0 +
5
5
10
10
15
15
20
20
25
.001
Starrett

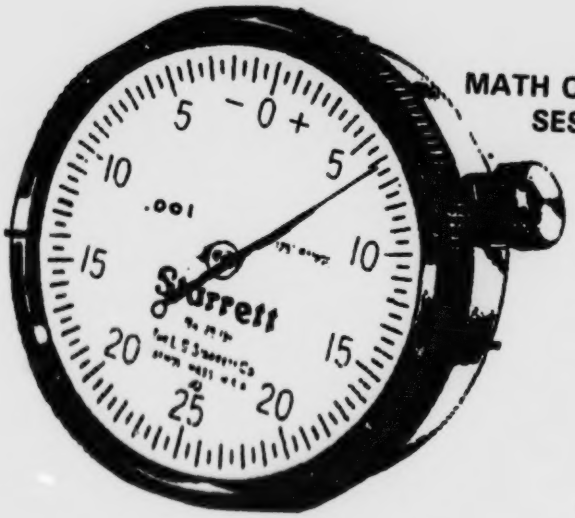
- 5

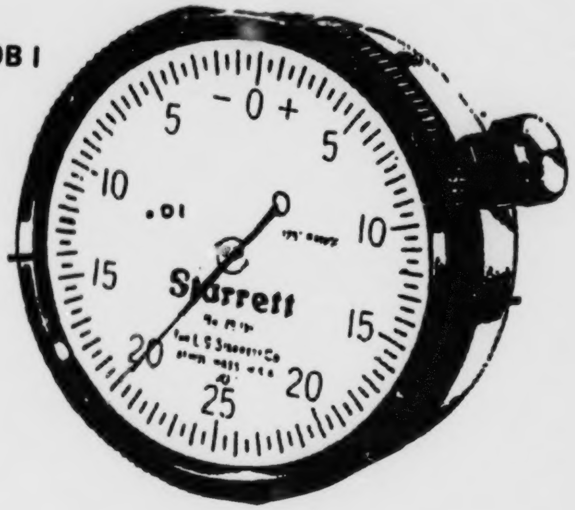
- .005 **- 5/1,000ths**


- 0 +
5
5
10
10
15
15
20
20
25
.01
Starrett

25

.25 **25/100ths**


5 − 0 + 5
.001
Starrett

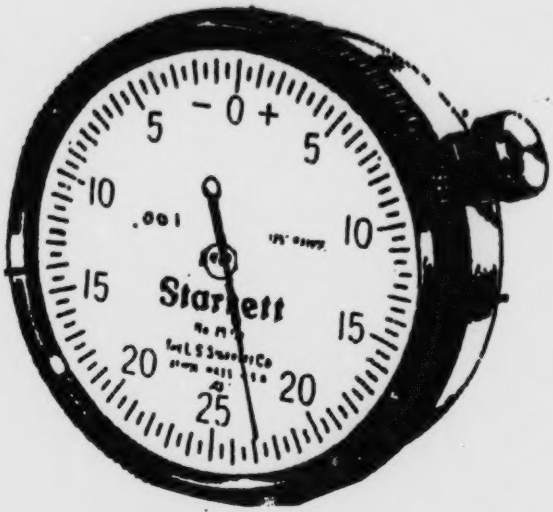

5 − 0 + 5
.01
Starrett

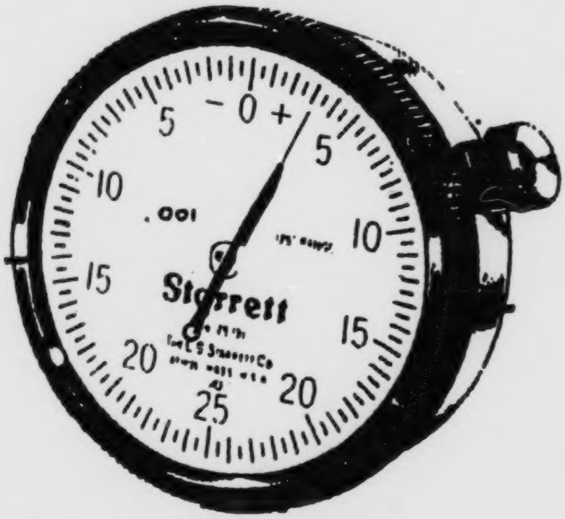
______

______ ______

______

______ ______


5 − 0 + 5
.001
Starrett


5 − 0 + 5
.001
Starrett

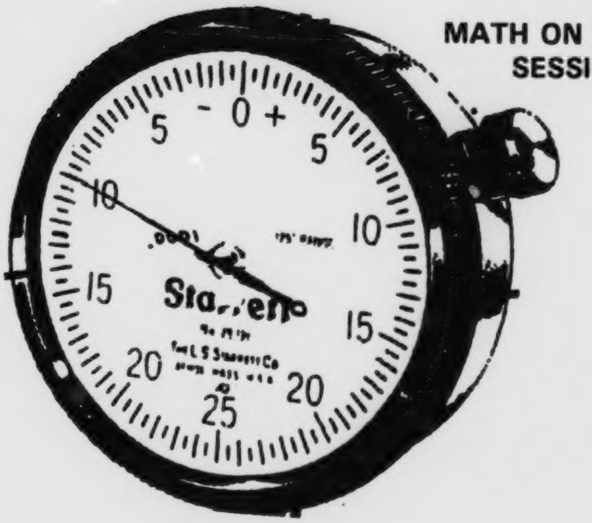
______

______ ______

______

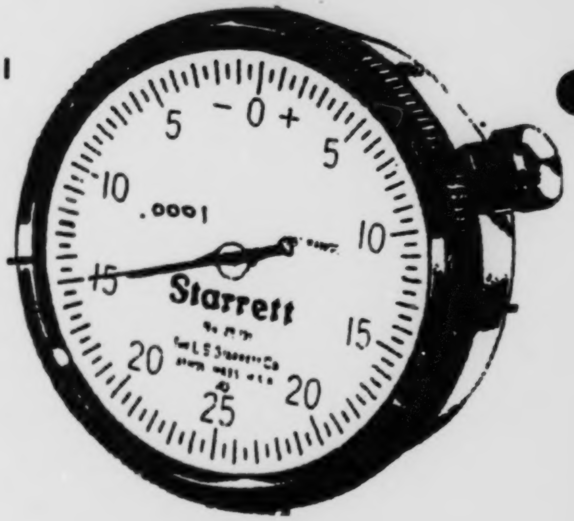
______ ______

MATH ON THE JOB I
SESSION 5


- 0 +
5
5
10
10
.0001
Starrett
15
15
20
20
25

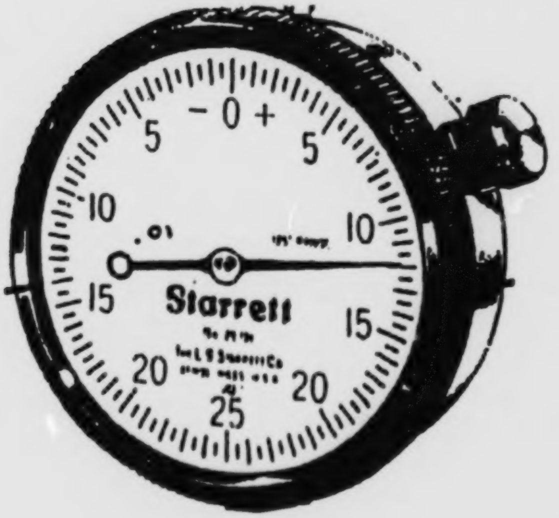
____

________ ________


- 0 +
5
5
10
10
.0001
Starrett
15
15
20
20
25

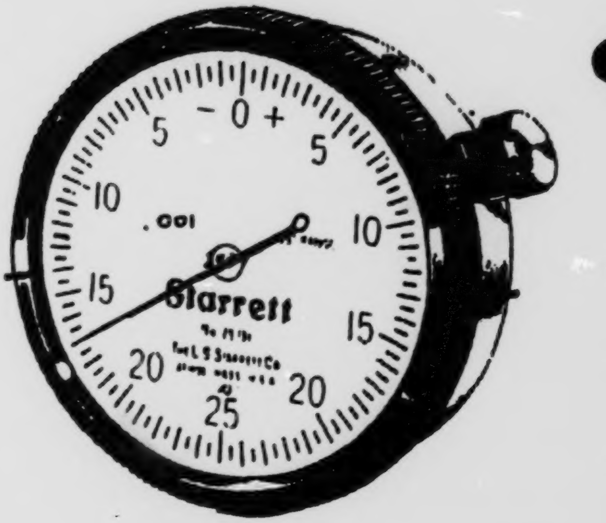
____

________ ________


- 0 +
5
5
10
10
.01
Starrett
15
15
20
20
25

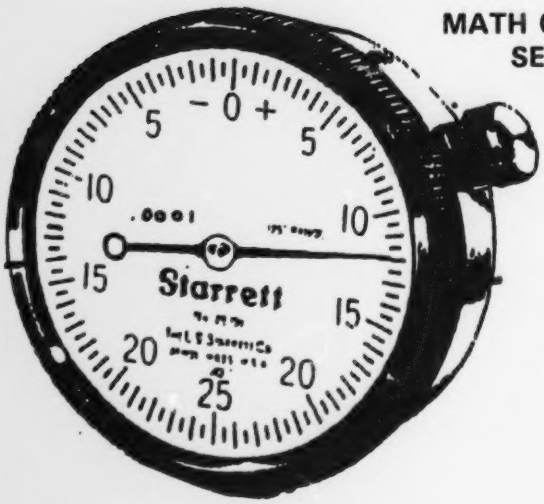
____

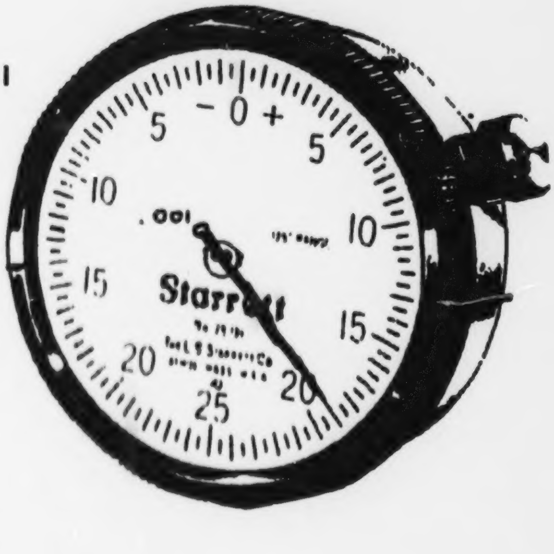
________ ________

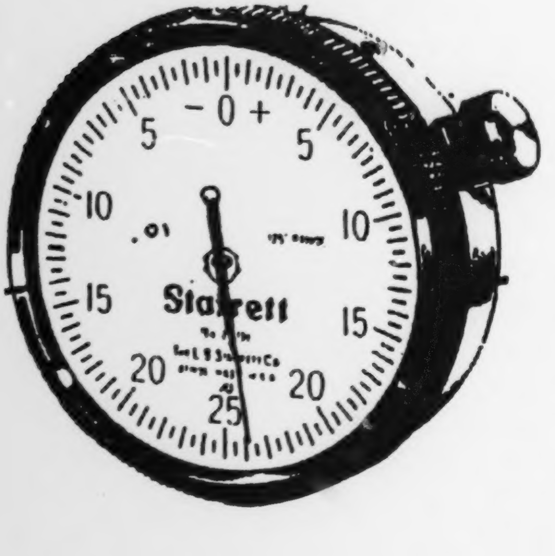

- 0 +
5
5
10
10
.001
Starrett
15
15
20
20
25

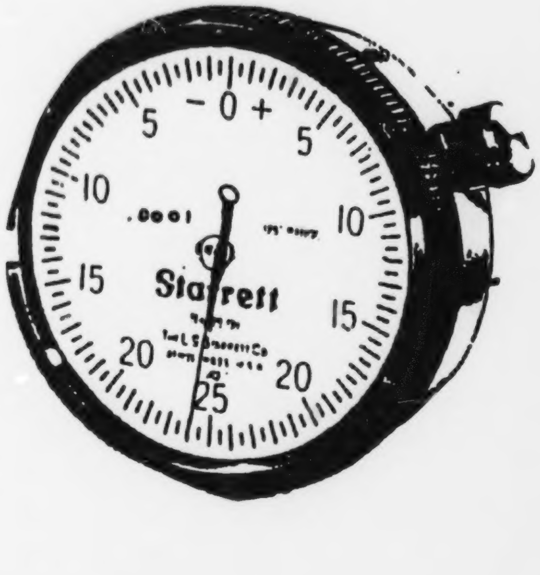
____

________ ________


5 − 0 + 5
.0001
Starrett


5 − 0 + 5
.001
Starrett

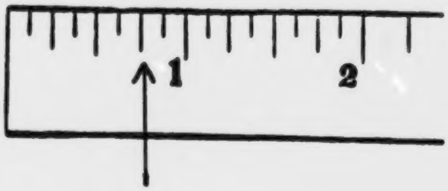

5 − 0 + 5
.01
Starrett

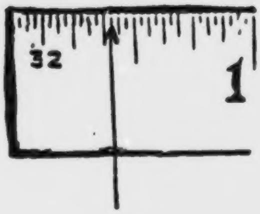

5 − 0 + 5
.0001
Starrett

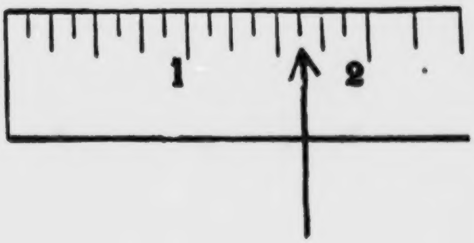
MATH ON THE JOB I
SESSION 5

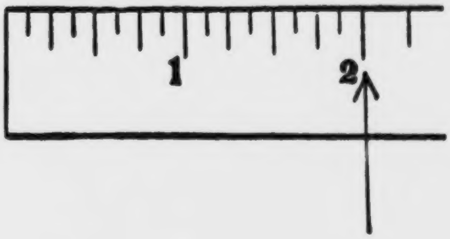
APPENDIX

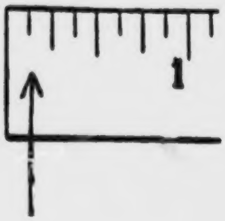
Write the measurements shown by the arrows on the following rulers, in fractions:

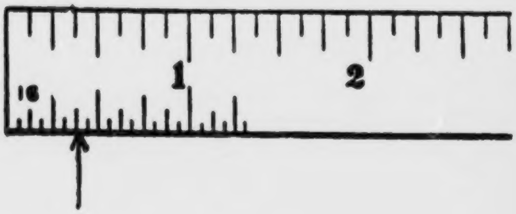


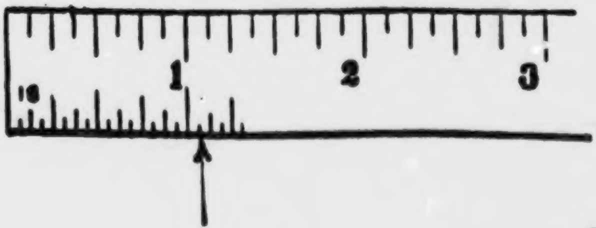


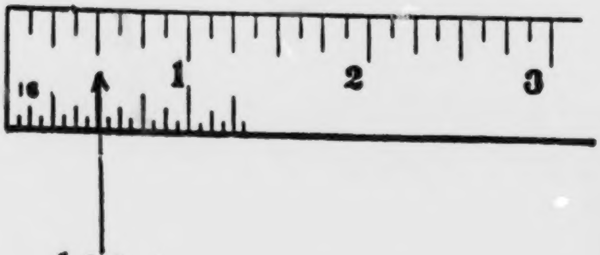












MATH ON THE JOB I
SESSION 5

APPENDIX (Cont.)

Round these numbers to 3 decimal places:

A. 21,376.4276

B. 10.37292

C. 1.2345678

D. 47.7030

E. 98,125.12556

F. 2.3212121212

G. 3.989421

H. 13.1424436

I. 24,388.8752

J. 16,235.1105279

Round these numbers to 4 decimal places:

A. 36,127.15214

B. 1.87842169

C. 42.495216

D. 3.78844

E. 29.1046327

F. 125,000.00009

CLEVELAND WOOD PRODUCTS

MATHEMATICS ON THE JOB I

OBJECTIVES

SESSION 6

- Demonstrate the ability to add and subtract decimals.
- Demonstrate the ability to solve decimal word problems involving addition and subtraction.

MATHEMATICS ON THE JOB I
SESSION 6

WORKING WITH DECIMALS

We use decimals daily, as we deal with dollars and cents. Decimals are used when a whole is divided into 10 equal parts or into equal parts that are multiples of 10 (such as 100, 1,000). In all cases, assume the decimal point "represents" 1, then add enough zeroes for each place. This number, then, becomes the denominator of the fraction.

Adding and Subtracting Decimals

Example	**Process**
4.27 .0812 33.69 + 5.1 43.1412 48.734 - 5.96 42.774 7.18 - 4.235 2.945	1. Arrange numbers in columns so that the decimal points line up. 2. Add or subtract the numbers as if the decimal points were not there. HINT: If there are blanks to the right of some numbers, treat the blanks as zeroes. It may even help you to put zeroes in place of the blanks, especially in subtraction. 3. Bring down the decimal point in the correct column.

MATHEMATICS ON THE JOB I
SESSION 6

Practice: Adding and Subtracting Decimals

A. 1.375 + .08 + 36.15 =

B. 42.1438 + 129.653 + 56.781 =

C. .4912 + .017 + .53 =

D. 2.798 + 35.2 + 4.674 =

E. 56.872 - 14.02 =

F. 425.68 - 45.926 =

G. .37915 - .0150 =

H. 2.78315 - .6543 =

I. 9.71 + 4.8 + 3.6 + 19.52 =

J. 489.76 + 21.42 + 19.3 + 8.5 =

MATHEMATICS ON THE JOB I
SESSION 6

Practice: Adding Decimals

826.28
53.6
+ 138.152

48.96
37.42
+ 99.2

472.1
81.73
+ 64.317

769.0
406.15
+ 83.911

25.653
18.92
+ 46.35

28.776
14.1
+ 39.25

76.5
89.39
+ 19.52

34.72
19.812
+ 4.6

23.77
95.3
+ 4.6

2.98
19.52
+ 14.2

39.765
8.31
+ 4.719

489.76
862.0
+ 73.25

MATHEMATICS ON THE JOB I
SESSION 6

Subtracting Decimals

In subtracting, as in adding, the decimal points must line up. If there are insufficient places around the decimal point, then zeroes should be filled in as necessary.

Practice

Remember to line up the decimal points!

A. 58.9 - 36.7 =

B. 146.35 - 58.98 =

C. 28.362 - 16.5 =

D. 59.7 - 38.914 =

E. 11.813 - 6.425 =

F. 35.15 - 19.37 =

G. 28.937 - 15.82 =

MATHEMATICS ON THE JOB I
SESSION 6

Practice: Subtracting Decimals

73.5 - 19.2	47.8 - 36.5	112.2 - 96.5
381.8 - 87.9	283.54 - 18.77	49.253 - 8.714
15.7 - 2.852	36.9 - 14.582	72.89 - 27.654
479.3 - 85.793	285.4 - 56.932	18 - .896
39.8 - 27.42	596.8 - 14.398	578.49 - 69.8
47.658 - 19.7	85.751 - 20.9	472.700 - 27.6

MATHEMATICS ON THE JOB I
SESSION 6

Practice: Decimal Word Problems

1. Tom Rodriguez has agreed to work 42.5 hours at a certain job to help out his friend, who wants additional vacation time and must get someone to cover his shift. He has already worked 16.345 hours. How many more hours must he work?

2. Jim Levy worked 4.5 days one week in February, 6.25 days another week, and 3.74 days a third week. Last year he called in sick so much that he was put on disciplinary probation. How many days did he work all together in February?

3. Maria Paulos works in the Paint Department, and uses both paint and turpentine in her job. The turpentine has become much more expensive lately. She used 7.65 gallons of paint Monday, 8.4 gallons Tuesday, 11.23 gallons Wednesday, 14.75 Thursday, and 9 gallons Friday. How much paint did she use this week?

MATHEMATICS ON THE JOB I
SESSION 6

4. Gloria Marichales studies Accounting at Cuyahoga Community College and needs 6 more courses to get her degree. She currently works in Accounts Payable, and wrote checks today for $172.15, $89.06, $122.43 and $19.25. Find the total of the checks.

5. Tom Lewis made $254.19 at the regular rate of pay and $76.49 at the overtime rate. In spite of the bigger checks he can bring home, he constantly argues with his wife about the amount of overtime he works. His tax deduction was $49.602. How much was his take-home pay?

6. The Kirby Company sent in a check for $38,427.19 in payment of invoice #12470. The payment was received 10 days late. However, the invoice amount was actually $38,247.19. How much should CWP return to the Kirby Company?

7. Cleveland Wood Products has been having a lot of trouble with its towmotors recently. They received a repair bill from The Towmotor Repair and Replacement Company for $2,835.76. Of that amount, $937.45 was for parts. How much did the labor cost?

8. At the beginning of March, the odometer of Dorothy Raymond's company car read 29,086.1 miles. At the end of March, it read 31,561.9 miles. How many miles did Ms. Raymond drive during the month?

9. Refer to the problem above. Suppose that in March, Ms. Raymond drove the car 897.4 miles on personal business. How many miles was the car driven on company business?

10. On February 1, The Brusch Company had $15,009.30 in its checking account. The Accounting Department transferred $5,637.99 to the savings account the next day. The Payroll Department is behind in its work by one week, and some workers did not get paid last week. After the transfer, how much did the Brusch Company have in its checking account?

MATHEMATICS ON THE JOB I
SESSION 6

APPENDIX

Practice: Adding Decimals

A. 4.98 + 2.17 =

B. 13.761 + 8.325 =

C. 17.921 + 111.1 =

D. 6.54 + 9.8 =

E. 12.94 + 6.083 + 74.1 =

F. 398.81 + 47.658 + 4,158.7 =

G. 3,217.6 + 895.41 + 37.288 =

H. 65.2 + 174.08 + 16.825 =

I. 7.5 + 9.83 =

J. 74 + 9.71 + 107.325 =

MATHEMATICS ON THE JOB I
SESSION 6

APPENDIX (Cont.)

Practice: Adding and Subtracting Decimals

19.74
- 6.58

27.8
- 23.605

786.1
- 4.271

386.021
59.8
+ 2.500

221.04
20.36
+ 1.3700

128.3506
15
803.25

8.34
- 5

4.2
- 1.379

114.809
- .69815

786.1
6.58
+ 1.2

89.06
8.39
+ 39.083

31.742
23.70
+ 3.2781

APPENDIX (Cont.)

Decimal Word Problems

1. Julio Gonzalez needed some office supplies and could not wait for the ordinary CWP supplier to deliver them. So he went to Office Maxx and bought $31.09 worth of supplies, which he paid for with a $50 bill from Petty Cash. How much change did he get?

2. Howard Smith needs to file his expense account report. He spent 1 night at the Macon Holiday Inn at $67.46 per night and rented a car for the weekend at a rate of $49.95. (All mileage was included in this rate.) He drove the car 916 miles. He spent 1 night with a relative in Atlanta to save the company a night of hotel expense. His meal expense was $59.86 the first day and $37.25 the second day. How much will the company reimburse him?

3. The Keller Company's bank statement showed a balance of $24,367.49 at the beginning of the month. During the month the following deposits were made: $183.50, $2,333.75, and $780.86. Also this month, the following checks were written: $2,715.50, $860.94, $16,735, and $953. Find the Keller Company's end of the month balance.

APPENDIX (Cont.)

Decimal Word Problems

4. Cleveland Wood Products asks that its salesmen use company credit cards to fill the tanks of company cars. The following receipts for gasoline purchases were turned in during the past month:

Amount Purchased	**Number of Gallons**
$11.98	11.2
$12.10	10.8
$16.22	14.1
$9.40	9.4
$7.04	6.7

How many gallons were purchased during this month? What was the total amount of the purchases?

5. The perimeter of a triangle is found by adding the lengths of all the sides together. If a triangle has the following sides, what is the perimeter? 4.5 inches, 3.75 inches, 5.125 inches

6. Find the perimeter of a box which measures 10.5 inches by 3.75 inches.

MATHEMATICS ON THE JOB I
SESSION 6

APPENDIX (Cont.)

Decimal Word Problems

7. A carpenter has to make some storage shelves for the Paint Department. Unfortunately, the power saw is broken and he will have to cut the shelves with a regular saw, which is more difficult and will take more time. The carpenter has a 16-foot board he is going to use. He wants to make 2 shelves which each measure 3.75 feet. How much wood will be left after he cuts the 2 shelves?

8. An executive needs to take a business trip, and decides to travel by car. He drove 4.5 hours on Monday, 12.75 hours Tuesday, 8.33 hours on Wednesday, and 15.125 hours on Thursday. What was his total driving time for the trip?

9. The company is installing new carpeting in the offices of the plant. The boss' office required 20.5 square yards of carpet, the secretary's office required 8.75 square yards, and the Accounting Department required 32.125 square yards. How much carpet was purchased, assuming there was no waste in cutting it to the appropriate size? If 3.25 square yards were wasted in the cutting, how much carpet would have to be purchased?

10. A dowel was required to be cut to 8.125 inches. However, by accident, the worker, who was new, misread the order and cut it to 7.625 inches. How much too short was the dowel?

OBJECTIVES

SESSION 7

- Demonstrate the ability to multiply and divide decimals.
- Demonstrate the ability to solve decimal word problems involving multiplication and division.

MATHEMATICS ON THE JOB I
SESSION 7

WORKING WITH DECIMALS

Multiplying Decimals

Example

$$\begin{array}{r} 2.65 \\ \underline{\times\ 3.3} \\ 795 \\ \underline{795} \\ 8.745 \end{array}$$

$$\begin{array}{r} .014 \\ \underline{\times\ .51} \\ 014 \\ \underline{070} \\ .00714 \end{array}$$

Process

1. Multiply the numbers first as if there were no decimal points.
2. Count the number of decimal places in the top number.
3. Count the number of decimal places in the bottom number.
4. Add the number of decimal places in the two numbers together.
5. Starting from the right, count over the same number of digits as the total number of decimal places in the numbers in the problem. Place your decimal point to the left of the digit.

NOTE: If there are not enough digits, you'll need to add zeroes to the left of the number.

MATHEMATICS ON THE JOB I
SESSION 7

Multiplying Decimals

$$\begin{array}{r} 39.6 \\ \times\ 4.8 \\ \hline \end{array}$$

$$\begin{array}{r} 18.7 \\ \times\ 2.3 \\ \hline \end{array}$$

$$\begin{array}{r} 47.63 \\ \times\ 2.61 \\ \hline \end{array}$$

$$\begin{array}{r} 21.43 \\ \times\ 12.15 \\ \hline \end{array}$$

$$\begin{array}{r} 65.3 \\ \times\ 4.6 \\ \hline \end{array}$$

$$\begin{array}{r} 7.51 \\ \times\ 8.2 \\ \hline \end{array}$$

$$\begin{array}{r} 280.9 \\ \times\ 6.85 \\ \hline \end{array}$$

$$\begin{array}{r} 73.52 \\ \times\ 2.34 \\ \hline \end{array}$$

$$\begin{array}{r} .093 \\ \times\ 5.6 \\ \hline \end{array}$$

$$\begin{array}{r} .042 \\ \times\ 3.2 \\ \hline \end{array}$$

$$\begin{array}{r} .571 \\ \times\ 2.9 \\ \hline \end{array}$$

$$\begin{array}{r} 21.7 \\ \times\ 6.1 \\ \hline \end{array}$$

MATHEMATICS ON THE JOB I
SESSION 7

Dividing Decimals

Examples

```
          9.7
  2.14 |20.758
       - 19 26
       -------
          1498
        - 1498
          ----
             0


           2.037
  4.22 |8.60000
       - 844
       -------
          160
          - 0
         -----
          1600
        - 1266
         -----
          3340
        - 2954
         -----
           386
```

Process

1. Eliminate the decimal point in the divisor by moving it the required number of places to make it a whole number.
2. Move the decimal point in the dividend the <u>same</u> number of decimal places as you did for the divisor. (You're not trying to make this number a whole number.)

   NOTE: If there are not enough places, you may need to add digits to the right of the dividend.
3. Divide as you would if there were no decimal points. Be sure to keep your numbers lined up.
4. Place the decimal point in the quotient directly above the <u>moved</u> decimal point in the dividend. This should be easy if your digits are correctly lined up.

MATHEMATICS ON THE JOB I
SESSION 7

Practice: Multiplying and Dividing Decimals

A. $.375 \times 2.9 =$

B. $22.450 \times .56 =$

C. $77.35 \times 2.5 =$

D. $.4187 \times .358 =$

E. $36 \div .47 =$

F. $6.2812 \div 2.3 =$

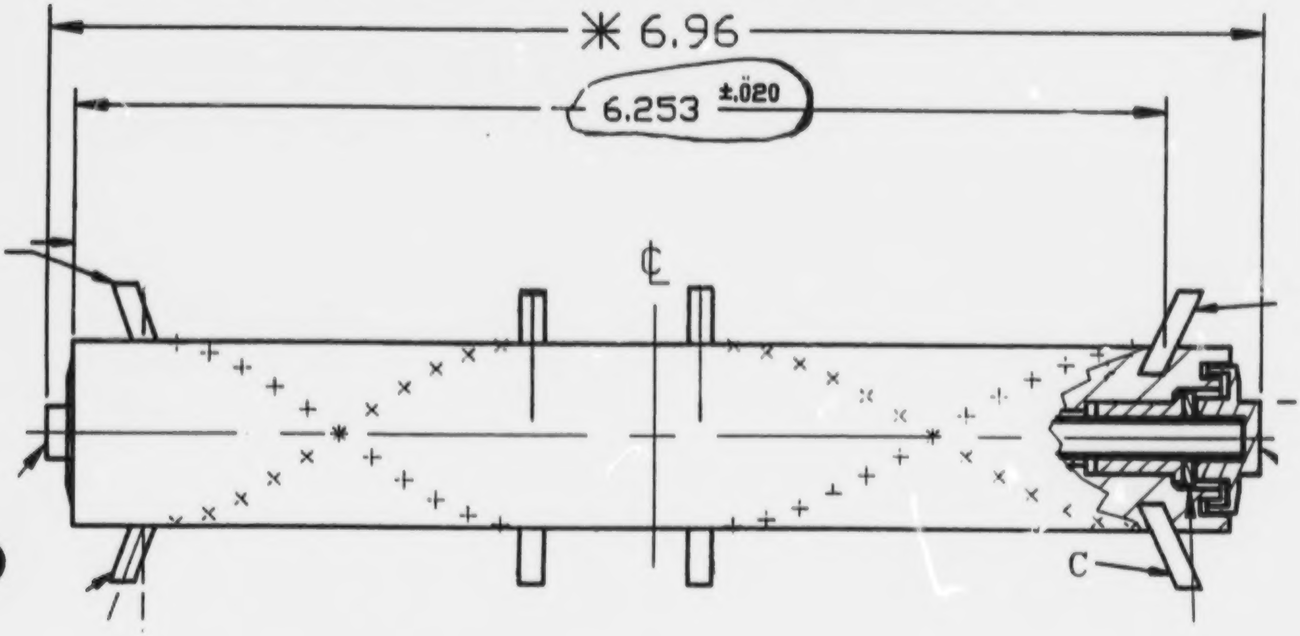
G. $127.91 \div 3.36 =$

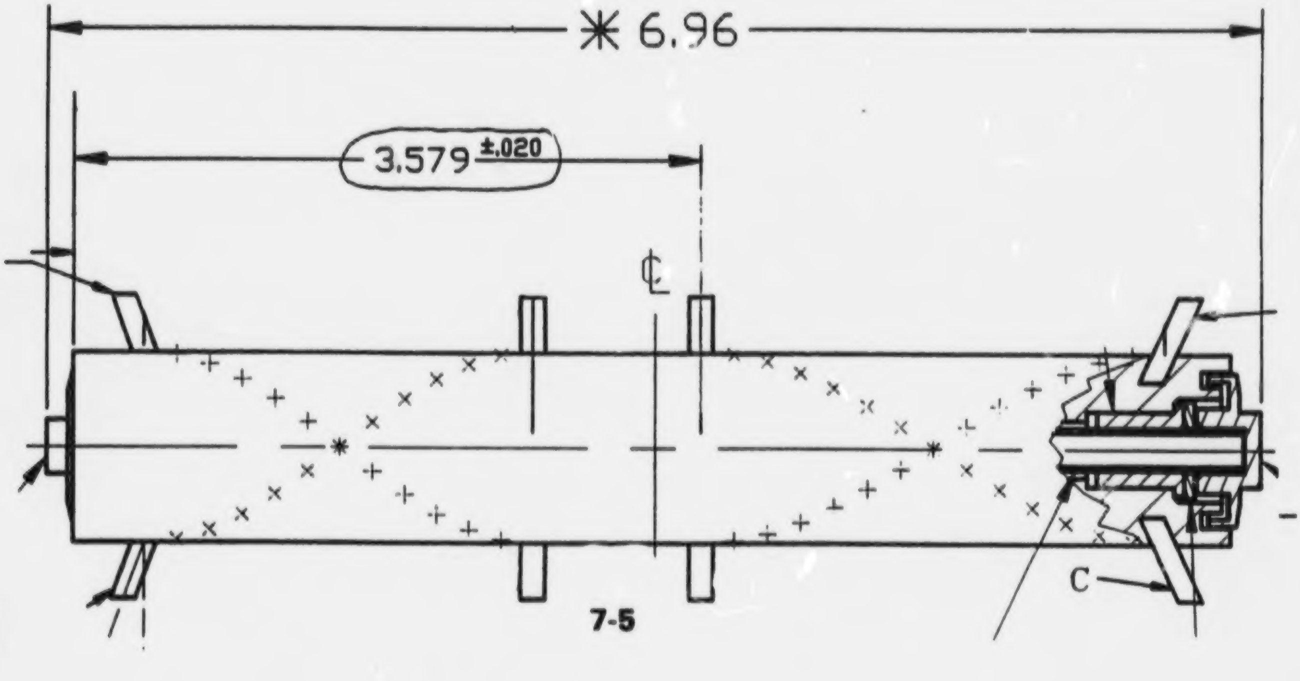
H. $4.9 \div .715 =$

MATHEMATICS ON THE JOB I
SESSION 7

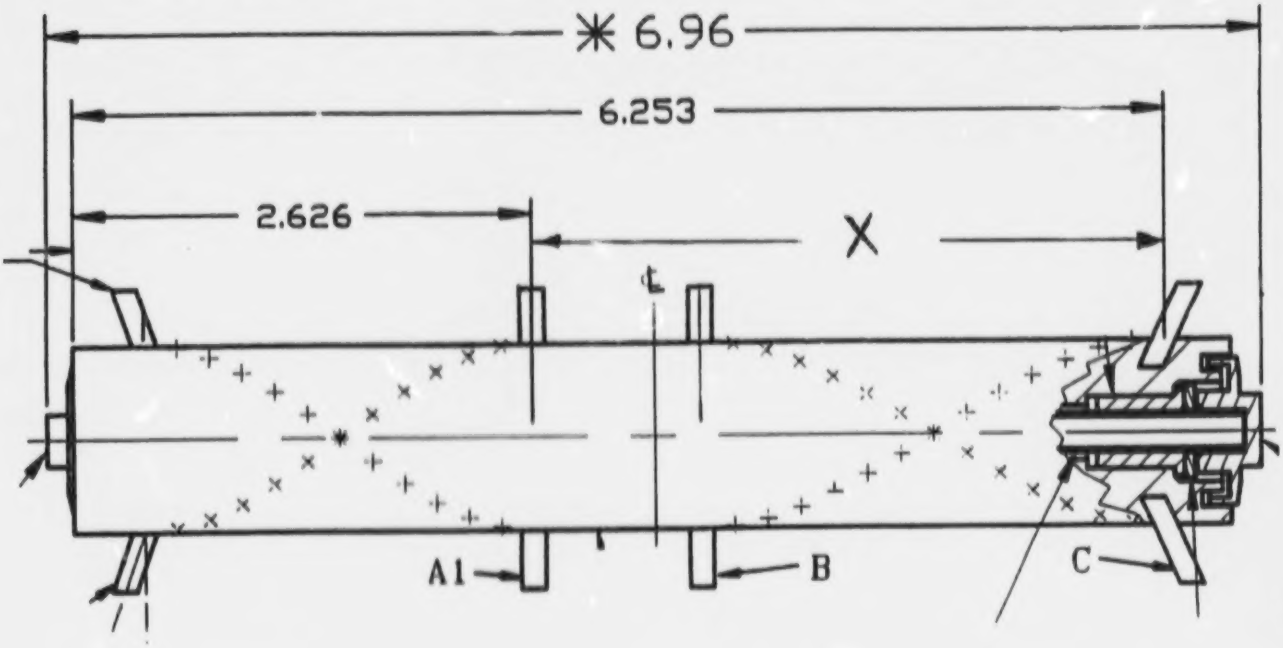
Practice: Word Problems

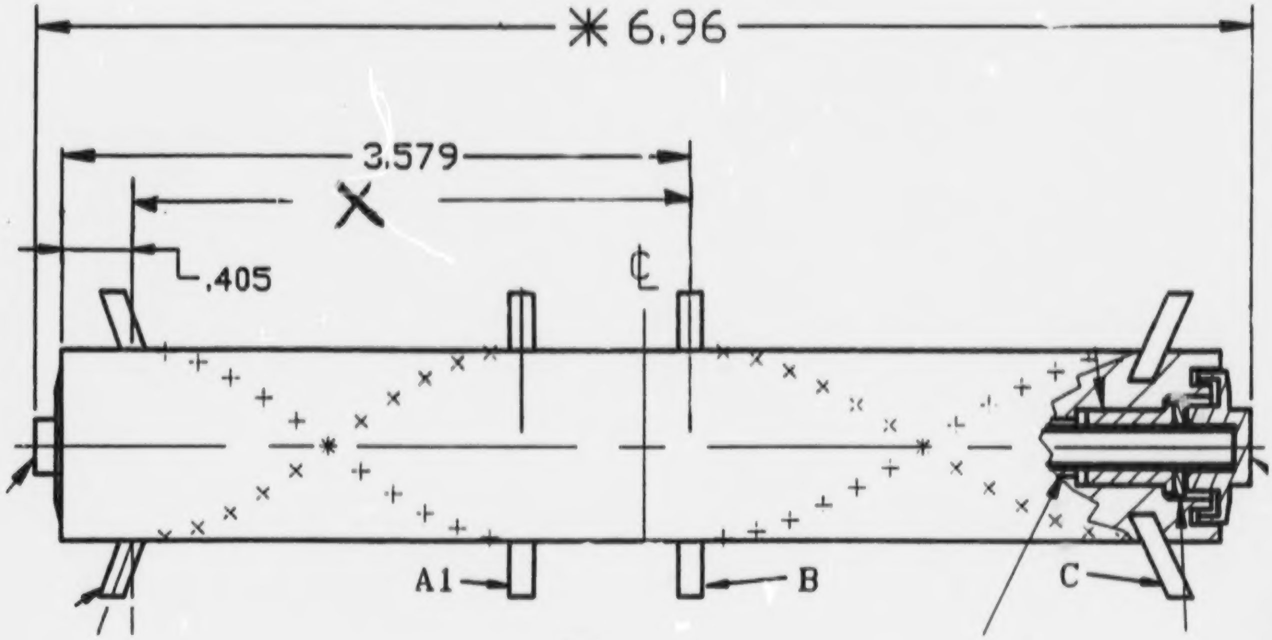
1. Find the upper and lower tolerances of the circled dimensions.


✳ 6.96
6.253 ±.020
℄
C


✳ 6.96
3.579 ±.020
℄
C

2. Find the X dimensions of each of the drawings below.


✱ 6.96
6.253
2.626
X
℄
A1
B
C


✱ 6.96
3.579
X
.405
℄
A1
B
C

MATHEMATICS ON THE JOB I
SESSION 7

3. A worker finally gets a $ .75 per hour raise. How much more money will this mean on a two week payroll period of 79.25 hours. (Round to 2 decimal places.)

4. The dowel should have been cut to 5.376", however, when it was measured, it was actually 6.001". What was the difference?

5. One dowel is 7.55 inches thick and another is 6.5 inches thick. How much thinner is the second dowel than the first?

MATHEMATICS ON THE JOB I
SESSION 7

Appendix
Additional Word Problems

1. Oil costs $.59 a quart. How much would 32 gallons of oil cost?

   Hint: There are 4 quarts in a gallon.

2. It takes 1.3 minutes to paint a dowel. How many dowels can you paint in an hour?

3. There are 575.35 square feet of floor space available for 4 workers with their machines. How many feet of floor space will each worker and machine receive if it is to be divided evenly?

MATHEMATICS ON THE JOB I
SESSION 7

Appendix
Additional Word Problems

4. A piece of wood 10.987 feet long is to be cut into 1.55 foot long pieces. How many pieces of the proper size can be cut from the wood?

5. A piece of wood 4.6 feet long is to be cut into 42 pieces of equal length. How many inches long will each piece be?

6. If your reject rate is .026, how many dirt magnets will be rejected out of a run of 573?

MATHEMATICS ON THE JOB I
SESSION 7

Appendix
Additional Word Problems

7. Laura's reject rate is .11. How many brushroll assemblies can she expect to reject out of a total of 350?

8. Downtime on Sam's center boring machine decreased by .03. If his machine used to be down about 40 minutes per shift, how many minutes will his machine be down after the decrease?

9. Ed produces 1.5 times as many dirt magnets as Martha. If Martha produces 211 dirt magnets per hour, how many dirt magnets per hour does Ed produce?

MATHEMATICS ON THE JOB I
SESSION 7

APPENDIX
Additional Word Problems

1. Cleveland Wood Products needs to purchase the following office equipment and supplies: two new typewriters costing $1,463.58 each, four calculators at $10.65 and three cases of copier paper at $89.95 each. There is a 7% (.07) sales tax. What is the total price of the office equipment and supplies?

2. The office staff also needs some miscellaneous supplies: 3 dozen Pilot pens at $1.39/pen, a new pencil sharpener at $17.55, and 12 new calendars for next year, at $7.99 each. Sales tax is 7% (.07). What will be the total bill?

MATHEMATICS ON THE JOB I
SESSION 7

APPENDIX
Additional Word Problems

3. To find the monthly interest due on a building owned by Epsilon Company, multiply the mortgage balance by .007292. Find the monthly interest on a mortgage having a balance of $242,798.46.

4. All employees at Seaview Market are hired to work a 40-hour week. If an employee works more than 40 hours a week, the employee is paid 1.5 times the regular hourly rate. For each employee, find the gross pay for the week.

Employee	Hours Worked	Hourly Rate	Gross Pay
Nicole	49.5	$8.25	
Carole	51	$12.74	
Thelma	54.6	$10.80	
Carlos	58.2	$14.35	

MATHEMATICS ON THE JOB I
SESSION 7

APPENDIX
Additional Word Problems

5. At the company picnic, one of the activities was a Mock Olympics. Results are given below:

Event	**Participant**	**Score**
Long jump	Stephanie	23 feet 5 inches
	Kurt	19 feet 3 inches
	Elena	24 feet
High jump	Maria	6 feet 1 inch
	Alex	5 feet 4 inches
	Mark	5 feet 1 inch
Crab walk	Juanita	2 minutes 35 seconds
	Julie	1 minutes 59 seconds

a, How much further did Stephanie jump than Kurt jumped? (Express your answer in decimal form rounded to 2 places.)

b. How much less did Mark jump than Alex? (Express your answer in decimal form rounded to 2 places.)

c. How much faster did Julie finish the Crab walk than Juanita? (Express your answer in decimal form rounded to 2 places.)

CLEVELAND WOOD PRODUCTS

MATHEMATICS ON THE JOB I

OBJECTIVES

SESSION 8

- Demonstrate the ability to convert between percents and decimals.
- Demonstrate the ability to use a calculator to solve decimal and percent word problems involving various operations.

MATHEMATICS ON THE JOB
SESSION 8

DECIMALS AND PERCENTS

What is a Percent?

A percent is a **fraction** that always has 100 as a denominator. To indicate that a number is a percent, a percent sign (%) is used. **You can easily remember that the denominator = 100, because the % sign looks like a number 1 between 2 zeroes. Any percent higher than 100 indicates a whole number, and may or may not include a fractional part.**

How many hundredths does each percent below indicate?

24% ____________________

75% ____________________

8.9% ____________________

1/2% ____________________

49% ____________________

5.7% ____________________

4.5% ____________________

80.4% ____________________

62% ____________________

82% ____________________

52.8% ____________________

700% ____________________

MATHEMATICS ON THE JOB
SESSION 8

Converting Decimals to Percents

To convert a decimal to a percent, move the decimal point 2 places to the **right** and add the percent sign (%). It is quite possible that you do not have 2 places to the right of the decimal point. In that case, just add zeroes until you get 2 places. Remember that **any percent greater than 100 represents a whole number,** and may or may not include a fractional part.

Examples

Convert the following decimal numbers to percents.

.86 = **86%**

.97543 = **97.543%**

0.8 = **80%**

0.62 = **62%**

0.06 = **6%**

1.4 = **140%**

Practice

Convert the following decimal numbers to percents:

0.17 =

0.005 =

0.37 =

5.01 =

0.201 =

9.5 =

0.318 =

0.047 =

MATHEMATICS ON THE JOB
SESSION 8

Converting Percents to Decimals

To convert a percent to a decimal, just move the decimal point 2 places to the left and drop the percent sign. If you do not have 2 places in the percent, add as many zeroes as you need, and then put in the decimal point.

Examples

Convert the following percents to decimals.

A. 89.75% = **.8975**

B. 70% = **.7**

C. 159% = **1.59**

D. 6.9% = **.069**

E. 3% = **.03**

F. 67% = **.67**

Practice

Convert each of the following percents to decimals.

A. 4% =

B. 110% =

C. 356% =

D. 85% =

E. 9.5% =

F. 53% =

G. 350% =

H. 0.27% =

I. 215% =

J. 32% =

K. 6.5% =

L. 1% =

MATHEMATICS ON THE JOB
SESSION 8

Calculator Practice

When you find a percent of a number manually, you need to change the percent to a decimal, and then multiply the decimal by the other number. For example, to figure out what 12% of 125 is, follow this process:

A. Change the percent to a decimal number:

12% = **.12**

B. Multiply the decimal number by the other number in the problem:

.12 x 125 = **15**

C. Therefore, 12% of 125 = 15.

Using a Calculator

Your calculator has a % sign. To calculate 15% of 125, press the 1, 2 and 5 keys,and then the "x" key. Then press the 1, 5 and the % key (don't have to hit =). Display will show the number that is 15% of 125. Try these sample problems:

A. 6% of 29 =

B. 5% of 67 =

C. 12% of 72 =

D. 50% of 19 =

E. 78% of 40 =

F. 13% of 84 =

G. 60% of 29 =

H. 54% of 60 =

MATHEMATICS ON THE JOB
SESSION 8

WORD PROBLEMS
Percent and Decimals

Practice

The Brandt Company is a supplier of office equipment and supplies. It recently sent a letter to all its customers describing a sale that the company is going to have. Listed below are the regular prices of several items, along with the discount prices. In each case, write the sale price of the item.

Item Number	Regular Price	Discount Percent	Calculation
123	$20.37	20%	
456	$125.79	15%	
789	$3,274.60	10%	
376	$278.89	25%	

MATHEMATICS ON THE JOB
SESSION 8

APPENDIX

Restating Percents as Fractions

How many hundredths are in each percent given below?

A. 900% =

B. 175% =

C. 8.75% =

D. 56% =

E. 0.35% =

F. 6% =

G. 7.2% =

H. 110% =

I. .5% =

J. 52.8% =

K. 79% =

L. 1.5% =

M. 13.2% =

N. 0.8% =

O. 91% =

P. 5% =

Q. 0.52% =

R. 8.1% =

S. 0.6% =

T. 11.5% =

U. 82% =

V. 130% =

W. 6.25% =

X. 0.3% =

Y. 5.75% =

Z. 4.09% =

MATHEMATICS ON THE JOB
SESSION 8

APPENDIX

Restating Decimal Numbers to Percents

Restate each decimal number as a percent.

A. 1.5 =

B. 2.36 =

C. 0.01 =

D. 0.11 =

E. 0.0323 =

F. 0.002 =

G. 0.626 =

H. 0.56 =

I. 0.464 =

J. 3.7 =

K. 0.18 =

L. 0.2313 =

M. 0.007 =

N. 0.131 =

O. 0.907 =

P. 0.999 =

Q. 0.39 =

R. 0.88 =

S. .125 =

T. 0.07 =

U. 0.907 =

V. 0.85 =

W. 6.5 =

X. 0.4 =

Y. 0.551 =

Z. 0.0035 =

MATHEMATICS ON THE JOB
SESSION 8

APPENDIX

Restating Decimal Numbers to Percents

Restate each decimal number as a percent.

A. 0.5545 =

B. 0.6 =

C. 0.77 =

D. 7.2 =

E. 0.09 =

F. 0.625 =

G. 0.41 =

H. 0.29 =

I. 4.92 =

J. 0.0061 =

K. 0.91 =

L. 0.894 =

M. 0.03 =

N. 0.6623 =

O. 0.84 =

P. 0.411 =

Q. 0.08 =

R. 0.004 =

S. 0.51 =

T. 8.25 =

U. 0.5 =

V. 0.0413 =

W. 0.73 =

X. 0.05 =

Y. 0.008 =

Z. 0.44 =

MATHEMATICS ON THE JOB
SESSION 8

APPENDIX

Restating Percents as Decimals

Restate each percent as a decimal.

A. 605% =

B. 95% =

C. 700% =

D. 8.5% =

E. 9% =

F. 12.7% =

G. 99% =

H. 80.4% =

I. 13% =

J. 800% =

K. 6.23% =

L. 41% =

M. 0.15% =

N. 5.13% =

O. 0.01% =

P. 147% =

Q. 4% =

R. 100.5% =

S. 3.5% =

T. 80% =

U. 150% =

V. 1.25% =

W. 1.2% =

X. 14% =

Y. 64% =

Z. 2.5% =

MATHEMATICS ON THE JOB
SESSION 8

APPENDIX

Restating Percents as Decimals

Restate each percent as a decimal number.

A. 125% =

B. 0.92% =

C. .75% =

D. 0.9% =

E. 35% =

F. 7.25% =

G. 8% =

H. 300% =

I. 0.1% =

J. 91.8% =

K. 620% =

L. 9.5% =

M. 7% =

N. 0.21% =

O. 4.09% =

P. 5.75% =

Q. 0.3% =

R. 6.25% =

S. 130% =

T. 82% =

U. 11.5% = .

V. 8.1% =

W. 0.52% =

X. 5% =

Y. 91% =

Z. 0.8% =

MATHEMATICS ON THE JOB
SESSION 8

APPENDIX

Calculator Practice

Using your calculator, work each problem.

A. 7% of 7.2 =

B. 4% of 9.6 =

C. 8% of 75.3 =

D. 9% of 61.5 =

E. 45% of 3.7 =

F. 62% of 0.93 =

G. 3.5% of 70 =

H. 4.2% of 39 =

I. 9.2% of 28 =

J. 4.5% of 90 =

K. 0.7% of 82 =

L. 0.5% of 35 =

M. 7.6% of 260 =

N. 5.8% of 430 =

O. 2.75% of 95 =

P. 6.25% of 75 =

Q. 150% of 40 =

R. 125% of 40 =

MATHEMATICS ON THE JOB
SESSION 8

APPENDIX

Percent and Decimal Word Problems

The Splitz Hardware Company is a supplier of paint and related supplies for smaller companies. It is going out of business, however, and has to liquidate all its inventory. The Office Manager of Abdec Company recently went to their warehouse and found the following sale prices indicated on signs. Listed below are the regular prices of several items, along with the discount prices. In each case, write the sale price of the item.

Item Number	Regular Price	Discount Percent	Calculation
A 320	$59.37	20%	
B 784	$15.34	12%	
C 120	$42.76	35%	
D 997	$132.49	49%	

MATHEMATICS ON THE JOB
SESSION 8

APPENDIX

Percent and Decimal Word Problems

1. Carmen earns $6.45 an hour. She gets 5 sick days a year, and 2 weeks of vacation. How much does she earn in a 7 1/2 hour day?

2. Find the cost of 2.75 gallons of paint at $24.39 a gallon. Spill-clean, used only occasionally in the paint shop, costs $35.00.

3. A survey at an intersection found that approximately 25 children were not riding in children's carseats. Of 2,200 drivers, 38% were wearing seat belts. How many drivers in the survey were wearing seat belts?

MATHEMATICS ON THE JOB
SESSION 8

APPENDIX

Decimal and Percent Word Problems

4. The Solar Bank offers scholarships to children of its employees. This year there were 37 applicants. However, only 25% of the applicants met the stated qualifications. How many applicants met the requirements?

5. At the State Stationery Company, 48% of the 160 employees carry medical benefits for their family. 15% do not have any medical coverage at all through this company.

   How many employees have only single coverage? How many employees carry family coverage?

CLEVELAND WOOD PRODUCTS

MATHEMATICS ON THE JOB I

OBJECTIVES

SESSION 9

- Demonstrate the ability to accurately fill out SPC charts used by CWP.
- Demonstrate the ability to use a calculator to solve decimal and percent word problems involving various operations.

MATHEMATICS ON THE JOB I
SESSION 9

Quality Control Reports

Introduction

This final chapter will require the application of the concepts you have learned so far to the workplace, and the specific reports workers at CWP are required to chart and fill out. Although actual forms have been used, the numbers on them may or may not be realistic; nevertheless, the forms will serve for practice, and discussion as to the purpose of Quality Control charting.

Quality Control charts, particularly when used in an automated environment, are not an attempt to track each worker's performance as much as a tracking of the performance of the various machines used in the workplace. Much like keeping track of your car's mileage on each tank of gas can alert you to problems which might require attention, so these charts can alert management to machines which might require servicing or adjustments.

Scrap/Rework Charts

The next two pages have scrap/rework charts. On each, do the following:

1. Determine how many pieces (total) need to be reworked/scrapped this week **for each reason**.
2. Determine the total pieces that need to be reworked/scrapped each day **for all reasons**.
3. Finally, determine the total pieces reworked/scrapped this week for all reasons.
4. If each piece scrapped/reworked costs CWP $4.00, what is **the total cost to the company for this week's scrap/rework?**

MATHEMATICS ON THE JOB I
SESSION 9

PART NUMBER: 661912-003 - RYOBI 12" BALL BEARING BRUSHROLL ASSY.
661912-004 - RYOBI 14" BALL BEARING BRUSHROLL ASSY.
661912-006 - RYOBI 14" BALL BEARING BRUSHROLL ASSY. (4 ROW)

REWORK AND SCRAP REPORT

SHIFT:

	MON	TUES	WED	THURS	FRI	SAT	TOTAL
LIST DATES HERE: REWORK:	3/6	3/7	3/8	3/9	3/10	3/11	
BERNELLED BEARING(S)	21	22	45	29	3	6	
MISSING TUFT(S)	18	19	13	7	4	7	
						TOTAL REWORK =	
SCRAP:							
CRACKED WOOD AT BEARING ASSY.	185	101	86	31		45	
HIT OFF(S)							
DEFECT IN WOOD							
NOT LOCKED IN (BRISTLER)	4	1	3	5	5	4	
SET-UP SCRAP		2	7	3	1	5	
TOO SHORT		1			1		
NO PAINT ON ONE SIDE	1		1		2		
						TOTAL SCRAP =	
INITIALS:							

MATHEMATICS ON THE JOB I
SESSION 9

PART NUMBER: 305889 - KIRBY GEN. 3 RUG RENOVATOR BRUSH

REWORK AND SCRAP REPORT

SHIFT:

	MON	TUES	WED	THURS	FRI	SAT	TOTAL
LIST DATES HERE: REWORK:	2/2	2/3	2/4	2/5	2/6	2/7	
MISSING TUFT(S)	4	6	35	4			
THIN TUFT(S)	15	20	22	25	31	10	
HIT OFF(S)	7		4	1	6	12	

TOTAL REWORK =

SCRAP:

HIT OFF(S)	4	4	9	8		1	
DID NOT SHIFT PROPERLY	2		1		1	1	
PATTERN OFF	3	3	2	4	3	2	
SET-UP SCRAP	1	6	2	4		1	

TOTAL SCRAP =

INITIALS:

MATHEMATICS ON THE JOB I
SESSION 9

Gage Charts

The next three pages have sample Gage Charts. On each chart, do the following:

1. Calculate the Specification upper and lower tolerance.
2. Calculate the Control Limits (both upper and lower).
3. Draw heavy lines on each chart at each of the four points you determined.

MATHEMATICS ON THE JOB I
SESSION 9

Part Number: D912

Part Name: 12" Ryobi Wood Dowel

Date:

Shift:

Operator:

CLEVELAND WOOD PRODUCTS
PRE CONTROL CHARTS

Characteristic: Overall Length

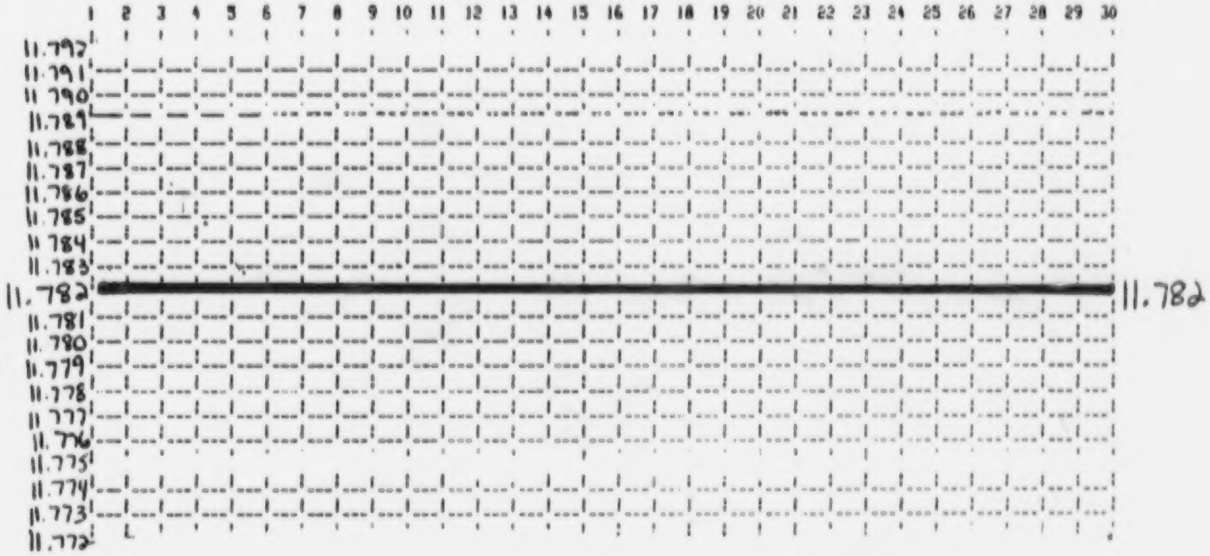
Specification: 11.782 ± .005

Gage: Height Gage #5002

Operation: CB/Double Ender

Control Limits 11.782 ± .003

Frequency: 2 pcs. every 2 hours



Characteristic: Outside Diameter Pulley

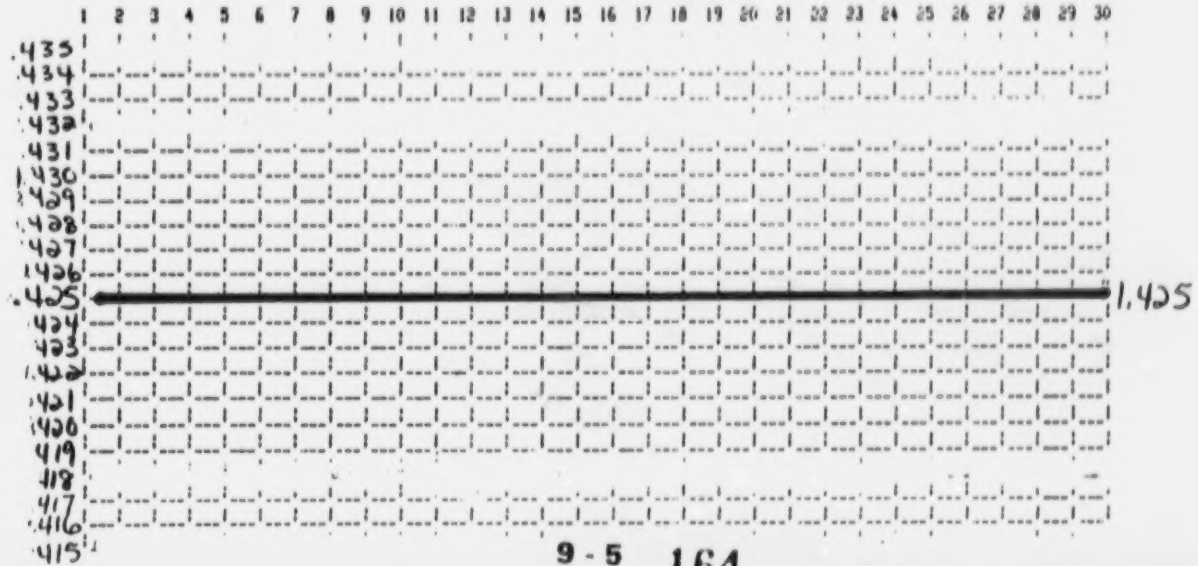
Specification: 1.425 ± .005

Gage: 2" Bench Micrometer #2048

Operation: Locatelli

Control Limits 1.425 ± .002

Frequency: 2 pcs. every 2 hours



MATHEMATICS ON THE JOB I
SESSION 9

CWP SPC CHART

Part Number: 80172 A

Part Name: Douglas Ring with Pin Brush

Characteristic: Trim Length

Operation: Trimmer

Date:

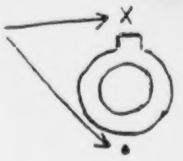
Shift:

Operator:

Specification: .625 ± .022

Control Limits: .625 ± .012

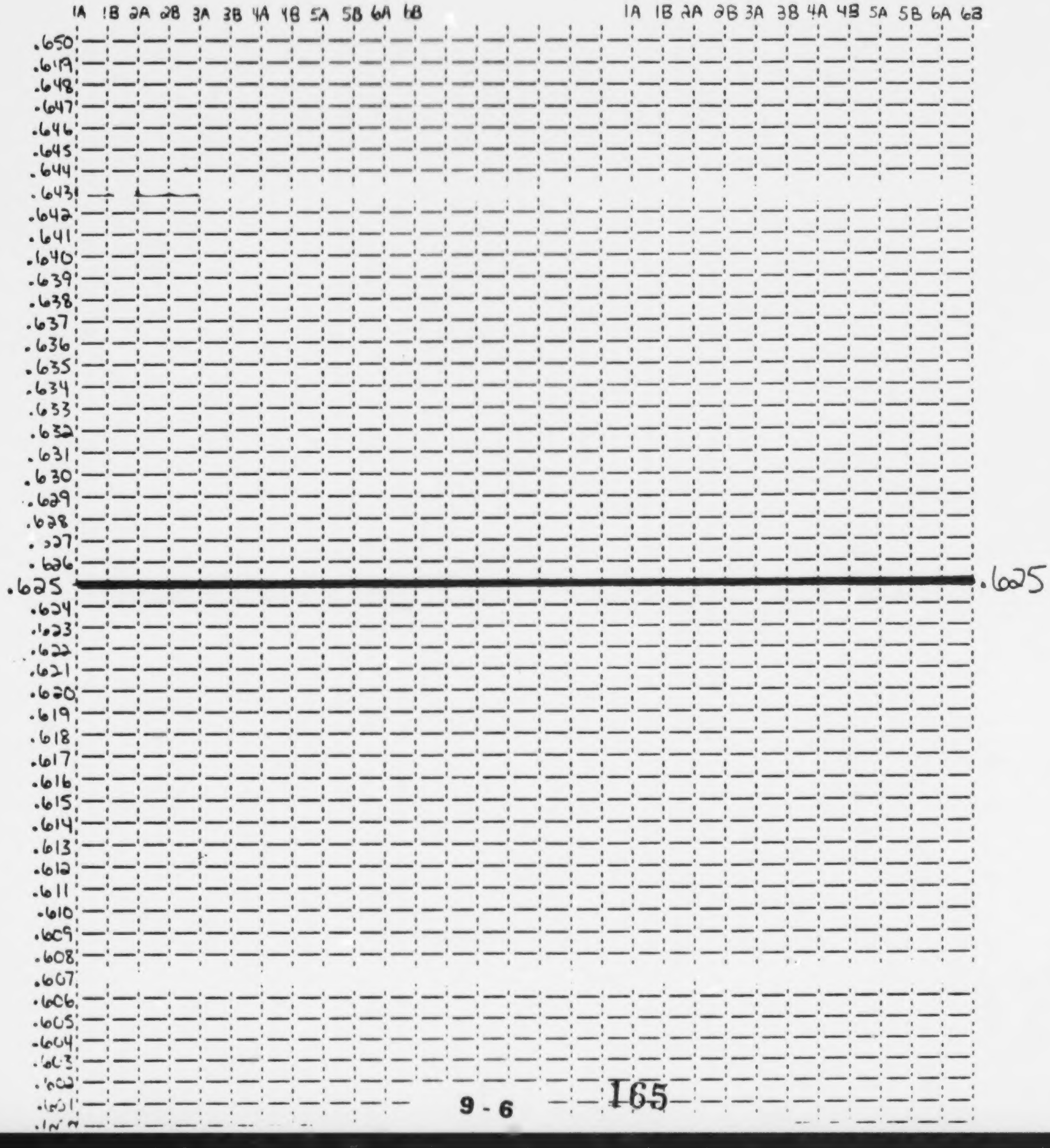
Measure in two places



Note: Verify presence of .500" off-center tuft.

Gage: Caliper

Frequency: 2 pieces each shift from each holder



MATHEMATICS ON THE JOB I
SESSION 9

CMP SPC CHART

Circle **Part Number:** 7540-0086/7540-0089

Part Name: Regina Dirt Magnet/ Lux Lite Brushroll Assembly's

Date:

Shift:

Operator:

X - white cap end

● - black cap end

Characteristic: Trim Diameter

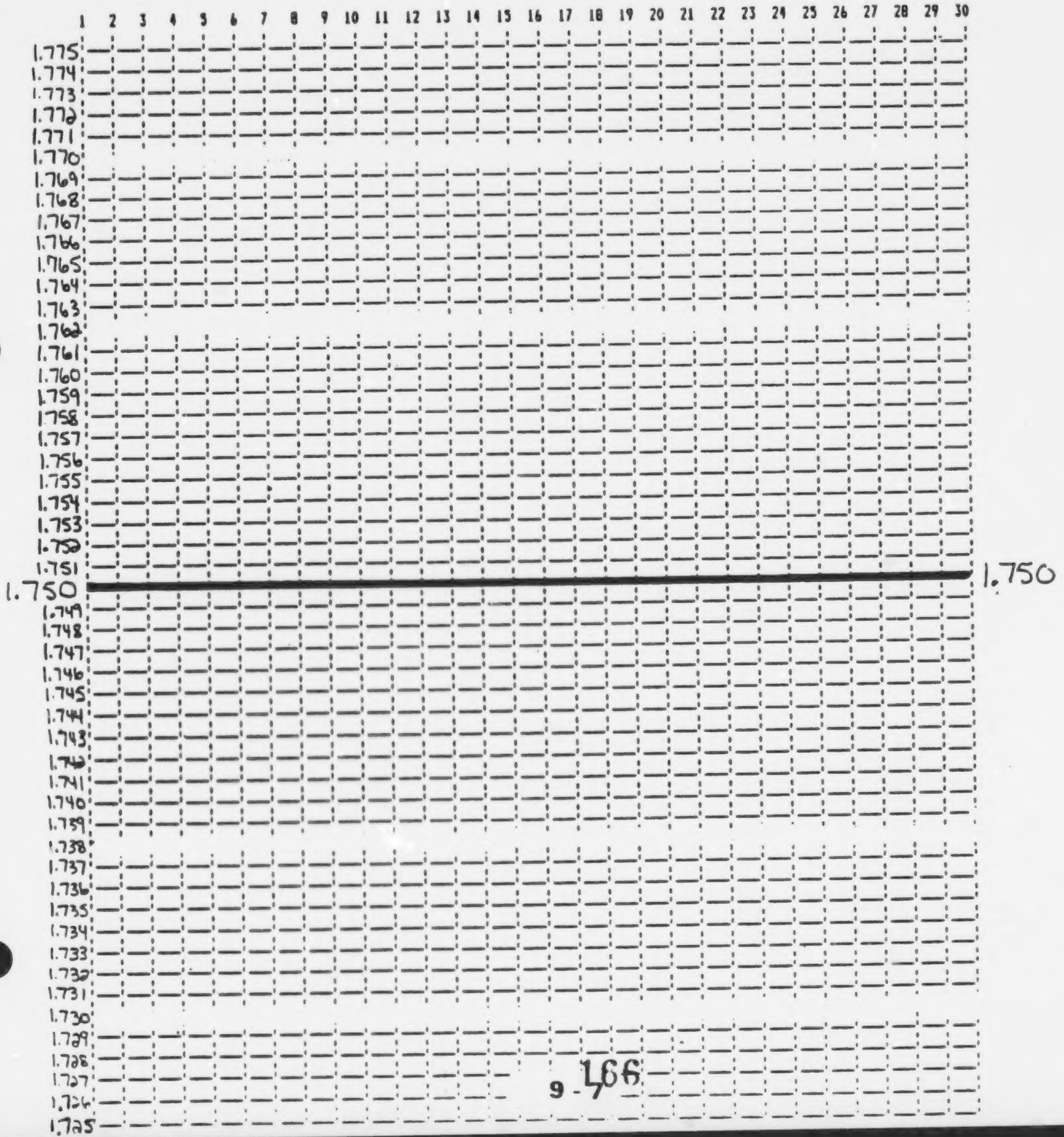
Specification: 1.750 ± .025

Gage: Caliper

Operation: Trimmer

Control Limits: 1.750 ± .014

Frequency: 2 pcs. every 3 hours



MATHEMATICS ON THE JOB I
SESSION 9

Production Sheets

These sheets will be explained here in considerable detail. The instructor will begin to work through them with you, then will allow you to work on them on your own. They will be corrected in class, and you will have a chance to ask any questions you may have.

Each piece of information has been labelled with a letter. Below is an explanation of each item:

> Down the left-hand side of the top page are numbers from 1 to 31. These are for the dates of the month. The dates of the month also appear on page 2, in a narrow column immediately to the right of column G, Total Man Hours.
>
> **A - Number of Starting Cartons (CTNs)**
> This is the number of cartons the workers in the cell found when they came to work in the morning. Normally, it should equal the number of ending cartons they had last evening.
>
> **B - Skids Pulled**
> The number of skids removed from their cell's work area during the day.
>
> **C - Ending Cartons (CTNs)**
> The number of cartons the workers left in their cell's work area when they left work for the day.
>
> **D - Quantity/Carton (Qty/Ctn)**
> The number of pieces per carton. This will vary, depending on the product being packed. **In this example, there are 35 pieces per carton.**

E - Cartons/Skid (Ctn/Skid)

The number of cartons per skid. **In this example, there are 40 cartons per skid.**

F - Total Pieces Produced (Total Produced)

You must calculate this number. The formula is as follows:

[C - A + (B x E)] x D or,

Ending Cartons minus Starting Cartons plus Total Cartons Pulled today (that is, number of skids pulled x number of cartons per skid). This answer, the number of cartons produced, should be multiplied by the number of pieces per carton to get the number of pieces produced.

G - Total Man Hours

You must calculate this number. The formula is as follows:

(I x J) - H or,

Number of hours in the shift x number of people in the cell

H - Manhours Lost

Total number of manhours the cell lost this shift is given, along with a reason for the lost manhours. For example, if there are 4.5 people in the cell, and the machine was down for 1 hour, manhours lost was 4.5 people x 1 hour = 4.5 manhours.

I - Number of people in cell

The workers in a particular cell will know this number. **For this example, use 4.5.**

J - Shift

The number of hours in the shift.

MATHEMATICS ON THE JOB I
SESSION 9

The Graph: Pieces per Manhour (Pcs/Manhr.)

You must graph the number of pieces produced per manhour, and must calculate the number. The formula follows:

F / G or,

Total pieces produced divided by Total Manhours.

Note: There is no place to write the answer to the above formula; you just need to indicate with a dot where on the chart it would fall.

After plotting all the points, the points should be connected with a solid line.

DATE	STARTING CTN	SKIDS PULLED	ENDING CTN	MAN HRS. LOST	REASON
1	Ⓐ 23	Ⓑ 2	Ⓒ 2	Ⓗ 4	NO SUB ASSY.
2	2	0	13	29	NO ROLLERS
3	13	0	13		NO ROLLERS
4	13	0	13		NO ROLLERS
5	13	0	30	10	BELT BROKEN; NO ROLLERS
6					WEEKEND
7					
8	30	2	2	4	HIT OFF
9	2	1	3	10	HIT OFF
10	31	1	18	24	WIRE HOLEY ROLLERS
11	18	1	36	6	WIRE HIT OFF
12	36	2	21	4	HOLEY ROLLERS
13					WEEKEND
14					
15	21	2	16	—	
16	16	2	2	4	HIT OFF WIRE
17	2	1	32	3	HIT OFF WIRE
18	32	2	29	—	
19	29	2	8	8	MACHINE BROKE
20					WEEKEND
21					
22	8	2	4	—	
23	4	1	37	1	HIT OFF
24	37	2	7	4	MISSING TUFTS
25	7	2	0	—	
26	0	1	10	10	SKID REJECT
27					WEEKEND
28					
29	10	2	2	6	HIT OFF
30	2	1	36	4	BELT BROKEN
31	36	2	14	3	HIT OFF WIRE

MATHEMATICS ON THE JOB I
SESSION 9

			PCS/MAN HR.																						
Ⓕ TOTAL PRODUCED	Ⓖ TOTAL MAN HRS.	DATE	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84
		1																							
		2																							
		3																							
		4																							
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		30																							
		31																							

Ⓘ NUMBER OF PEOPLE IN CELL = 4.5

Part # ______________

Description ______________

Month ______________

Shift DAYS (8 HRS) Ⓙ

Qty/Ctn 35 Ⓓ

Ctn/Skid 40 Ⓔ

MATHEMATICS ON THE JOB I
SESSION 9

Additional Word Problems

1. At a particular factory, there are 25 center boring machine operators, 10 quality control inspectors and 5 people in the Paint Shop. Another 25 are engaged in packing the product for shipment. There are 100 employees in total. What is the percentage of each type of worker?

2. Ariel Secretarial Service bills its clients in tenths of an hour, at an hourly rate of $14.35. Because CWP had a critical administrative employee out on extended sick leave, it contracted with Ariel to provide certain secretarial services. On Monday, the service did 5.7 hours of work for CWP; on Tuesday, 6.2; on Wednesday, 1.4; on Thursday, 3.8; and on Friday, 8.3. How much did Ariel bill CWP?

3. In the Ohio Tufts Company factory, each run of tufts is checked manually for acceptable quality, before being shipped out. The first week of this month, the reject rate on a run of 35,487 sets of tufts was .012. How many sets of tufts were rejected?

4. In one shipment, 1.68% of the 27,800 crates were damaged. How many crates were damaged? If the insurance will pay $4,362.25 for each damaged crate, how much should the company bill the insurance company?

5. This month's sales goal for Easy Writer Pen Company is 2,380,000 ball-point pens. If the company has reached 77.5% of its goal, how many pens have been sold so far?

6. Marcos just got his paycheck. His gross pay was $1,235.79, and he had the following deductions: health insurance $125.26; United Way $10; dental insurance $32.40; savings bonds $20; federal tax $185.39; state tax $123.58; social security tax $92.68. How much was Marcos' take-home pay?

7. Total daily circulation of the *Herald* is 180,000. If complimentary (non-paid) circulation is 5,400 copies a day, and the daily price of the newspaper is $ .35, how much money is the *Herald* earning each day? What is the value of the papers it gives away for promotional purposes?

MATHEMATICS ON THE JOB I
POST-ASSESSMENT

I. Write the following as whole numbers:

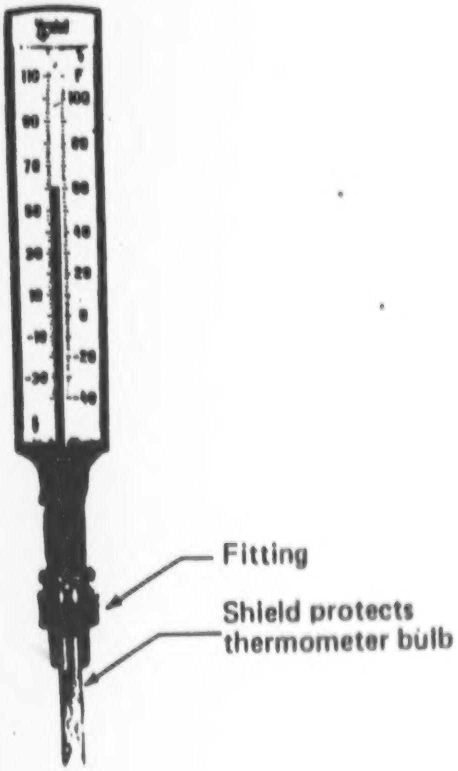
A. Four hundred thousand nine hundred eighty-six

____

B. Seven million eight hundred twenty-one thousand one hundred thirty-three

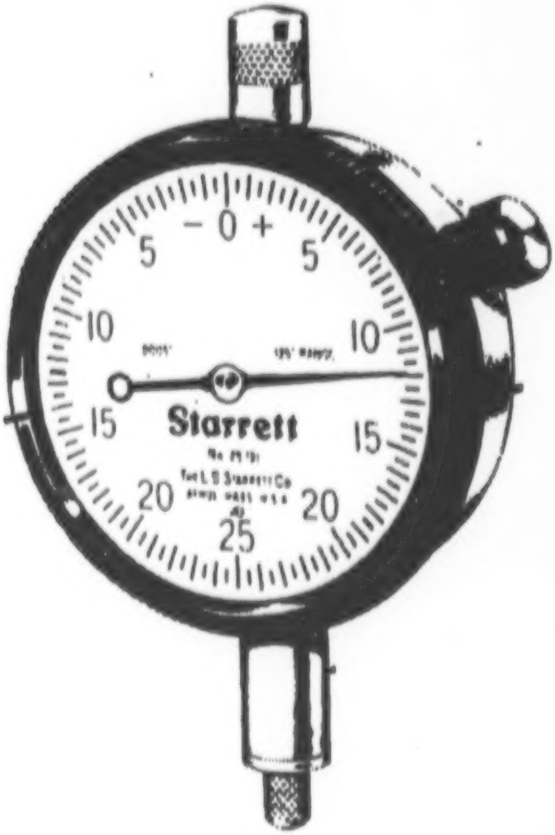
____

II. A. The mercury on this thermometer reads at ______ degrees F.


Fitting
Shield protects thermometer bulb

B. The dial on this indicator points to the number ________.

This is read as ____________.


– 0 +
5
5
10
10
15
15
20
20
25
Starrett

III. Add the following numbers:

A. 415
+ 932

B. 18,441
59,609
+ 23,484

IV. Subtract the following numbers:

A. 495
- 23

B. 88
- 74

V. Solve the following problems:

A. An automatic machine requires servicing after every 300 hours of operation. If the operating-time indicator now reads 193 hours, how many hours remain before the next service is required?

B. Add the Pieces Scrapped due to cracked wood at the bearing assembly.

____

SCRAP:

CRACKED WOOD AT BEARING ASSY.	185	101	86	31		45	
HIT OFF(S)							
DEFECT IN WOOD							
NOT LOCKED IN (BRISTLER)	4	1	3	5	5	4	
SET-UP SCRAP		2	7	3	1	5	
TOO SHORT		1			1		
NO PAINT ON ONE SIDE	1		1		2		
INITIALS:						TOTAL SCRAP =	

VI. Multiply the following numbers:

A.
$$\begin{array}{r} 812 \\ \times\, 716 \\ \hline \end{array}$$

B.
$$\begin{array}{r} 8,421 \\ \times\, 18 \\ \hline \end{array}$$

VII. Divide the following, and indicate the remainder, if any.

A. $184 \div 23 =$

B. $64\overline{)9245}$

VIII. Solve the following problems:

A. Yesterday, 347 boxes of 32 brush assemblies each were packed in your department. How many brush assemblies total were packed?

B. Find the average number of pieces reworked due to Bernelled Bearings.

____

PART NUMBER: 661912-003 - RYOBI 12" BALL BEARING BRUSHROLL ASSY.
661912-004 - RYOBI 14" BALL BEARING BRUSHROLL ASSY.
661912-006 - RYOBI 14" BALL BEARING BRUSHROLL ASSY. (4 ROW)

REWORK AND SCRAP REPORT

SHIFT:

	MON	TUES	WED	THURS	FRI	SAT	TOTAL
LIST DATES HERE: REWORK:	3/6/93	3/7/93	3/8/93	3/9/93	3/10/93	3/11/93	
BERNELLED BEARING(6)	21	22	45	29	3	6	
MISSING TUFT(9)	18	19	13	7	4	7	

TOTAL REWORK =

IX. Convert the following:

A. Write the fraction equivalent of .500. ____________________

B. What is the decimal equivalent of 1/4? ____________________

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X. Add the following decimal numbers:

A. .836 + 1.59 + 42.64 =

B. 49.23 + .80 + 7.41 =

XII. Subtract the following decimal numbers:

A. 18.449 - .671 =

B. 8.224 - .55 =

XIII. Solve the following problems using the Rework and Scrap Report given below for 12" Ball Bearing Brushroll Assemblies:

SCRAP:

CRACKED WOOD AT BEARING ASSY.	185	101	86	31		45	
HIT OFF(S)							
DEFECT IN WOOD							
NOT LOCKED IN (BRISTLER)	4	1	3	5	5	4	
SET-UP SCRAP		2	7	3	1	5	
TOO SHORT		1			1		
NO PAINT ON ONE SIDE	1		1		2		
INITIALS:						TOTAL SCRAP =	

A. How many brushroll assemblies were scrapped during the week because they were not locked in? __________

B. If each piece of scrap costs Cleveland Wood Products $4.00, what is the expense for all brushroll assemblies scrapped (for any reason) during this week? __________

XIV. Multiply the following decimal numbers:

A. 8.83 x 92.4 =

B. .855 x 1.5 =

XV. Divide the following decimal numbers. Carry your answers out to 3 decimal places.

A. 82.4 ÷ .58 =

B. 77.51 ÷ 8.9 =

XVI. Solve the following problems:

A. You worked 187.5 hours in 2.5 weeks. How many hours did you average per week? ______________

B. You can earn 2 vacation days each month. How many days of vacation would you have at the end of 6.5 months? _________________

XVII. Solve the following word problems.

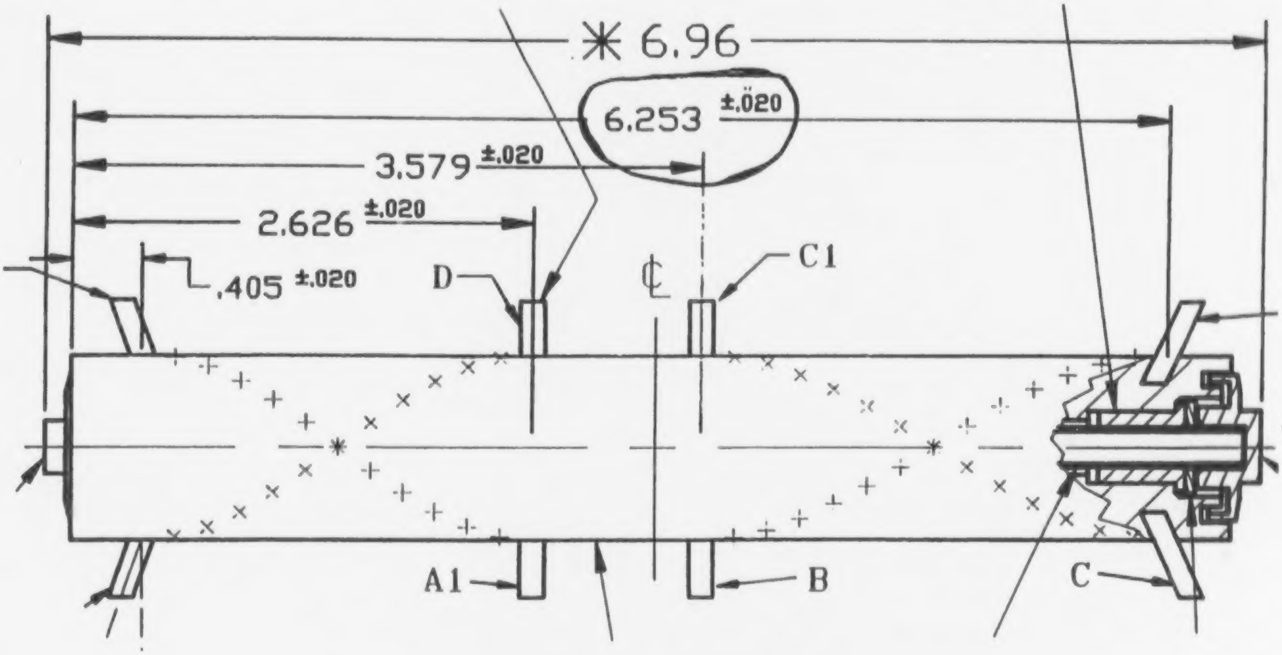
A. Currently, Tina paints 475 dowels a day. She needs to increase her production by 7%. How many dowels will she need to paint each day?

B. Anna works overtime every week; she is paid time and a half for any hours over 40 each week. Her hourly wage is $12.50. In February of this year, Anna worked 55 hours the first week, 63 hours the second week, 42 hours the third week and 60 hours the last week. How much did Anna earn (before taxes or other deductions were taken out of her check)?

C. You accrue sick time at the rate of .5 days per every 2 months worked. At the end of one year, how much sick time have you accrued?

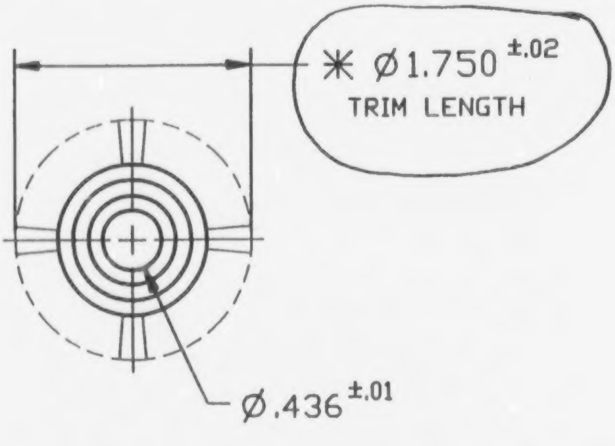
D. Find the upper (+) tolerance on the circled length.

____


✳ 6.96
6.253 ±.020
3.579 ±.020
2.626 ±.020
.405 ±.020
D
℄
C1
A1
B
C

E. What is the lower (-) tolerance for the circled dimension?

____


✳ Ø1.750 ±.02
TRIM LENGTH
Ø.436 ±.01

MATHEMATICS ON THE JOB I
QUIZ 2

I. Add or subtract the following decimal numbers. Round to 2 decimal places.

A. .768 + 13.42 + .0869 =

B. 3.15 + 125 + .5951 =

C. 10.19 - 6.4532 =

D. 16.07 - 8.1 =

E. .750 + .00160 =

II. Multiply or divide the following decimal numbers. Round to 3 decimal places.

A. 16.75 x 8.4 =

B. 65 / 1.54 =

C. 59.78 / .443 =

D. .7875 x 6.2 =

MATHEMATICS ON THE JOB I
QUIZ 2

III. Solve the following word problems:

A. Alex Chakkas drove a company car on a recent business trip. He drove 35.9 miles Monday, 263.8 miles on Tuesday, 134 miles on Wednesday, 176.2 miles on Thursday, and only 25 miles on Friday. How many miles did he drive all together?

B. José earns an hourly rate of $13.27. His time card shows the following work schedule for last month. How much were his wages for the month? (José is paid time and a half for any hours over 37.5 per week.)

Wk	Hrs. Worked
1	42.75
2	53.25
3	38.25
4	57.375

MATHEMATICS ON THE JOB I
QUIZ 2

C. If the specification of a trim length is .625 plus or minus .030, what are the upper and lower control limits?

D. If a towmotor can go for 375 miles between servicing, and it has been driven 139.6 miles already, how many miles are left before the servicing?

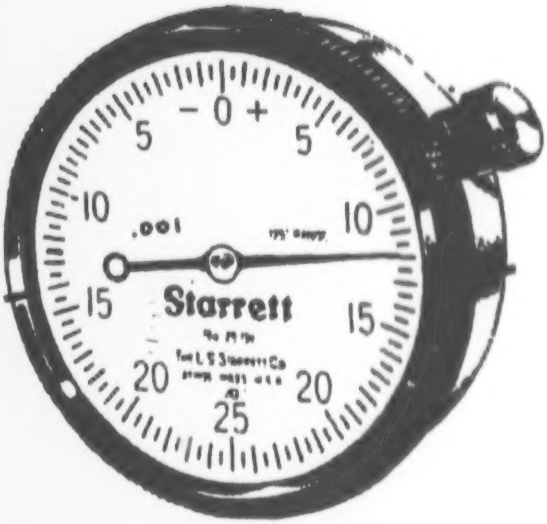
E. A salesman stopped to buy gas for his car. If the gas cost $1.09 per gallon, and he purchased 16.4 gallons of gas, how much did he spend?

MATHEMATICS ON THE JOB I
QUIZ 2

F. What do the needles show on the following gages? How is that read? (Give the fractional equivalent.)

________________ ________________

________________ ________________



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Starrett
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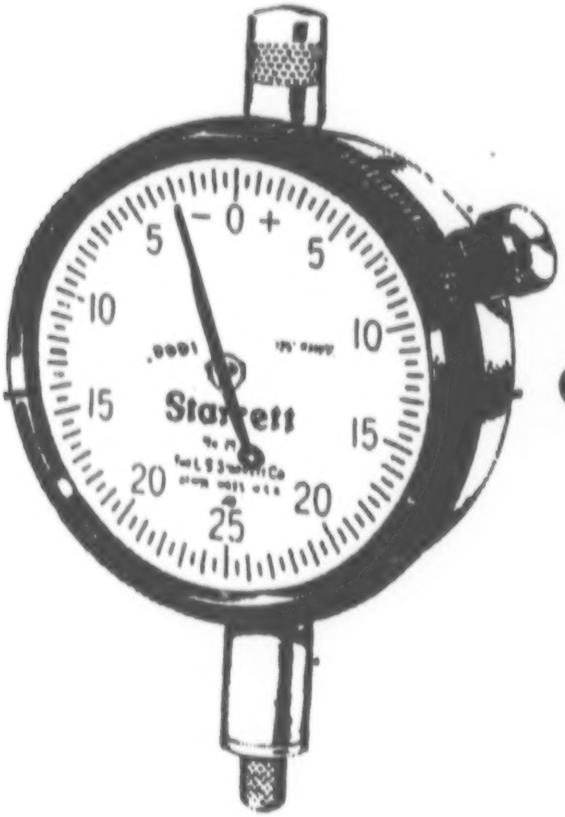

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.0001
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Starrett
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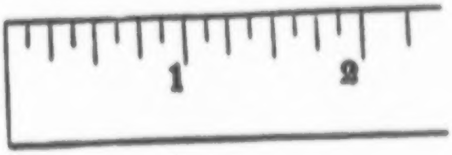
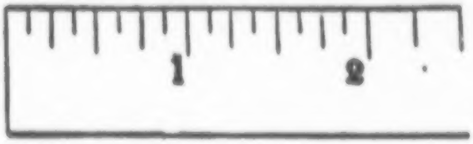
MATHEMATICS ON THE JOB I
QUIZ 2

G. Draw an arrow on each of the following rulers which represents the measurement given.

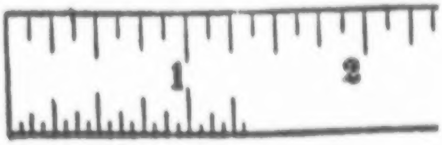
3/8"



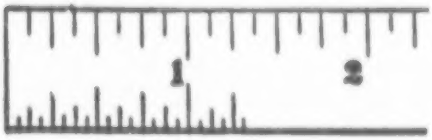
1/4"



7/16"



1/2"



MATHEMATICS ON THE JOB I
QUIZ 1

Write the following as whole numbers:

1. Four hundred thousand nine hundred eighty-six

____

2. Seven million eight hundred twenty-one thousand one hundred thirty-three

____

3. Two thousand nine hundred fifty-four

____

4. Nine hundred seventy-six billion eight hundred fifty-six million ninety-one thousand forty-four

____

Put commas in the following numbers:

5. 7 6 4 9 0 8 3

6. 1 0 4 3

7. 5 6 7 3 4 0

MATHEMATICS ON THE JOB I
QUIZ 1

Add the following numbers:

8.
$$\begin{array}{r} 4 \\ 7 \\ +\ 5 \\ \hline \end{array}$$

9.
$$\begin{array}{r} 67 \\ 88 \\ +\ 43 \\ \hline \end{array}$$

10.
$$\begin{array}{r} 1{,}276 \\ +\ 7{,}893 \\ \hline \end{array}$$

11.
$$\begin{array}{r} 873 \\ +\ 452 \\ \hline \end{array}$$

12. List all the ways you can think of to change the order of the numbers below according to the commutative property.

6 + 10 + 4

MATHEMATICS ON THE JOB I
QUIZ 1

13. Are the following mathematical statements true or false?

a.) 1 + 3 + 5 = 5 + 3 + 1

b.) 10 + 17 + 91 = 91 + 17

14. List 3 different ways to group the numbers below according to the associative property.

2 + 4 + 8 + 16 + 20

15. Are the following mathematical statements true or false?

a.) (9 + 1) + (7 + 10) = 9 + (1 + 7) + 10

b.) 17 + 89 + (35 + 76 + 90) = (17 + 89) + 35 + 76 + 90

Subtract the following numbers:

16. 78 - 42 = ____

17. 919 - 765 = ____

18. 16,786 -5,927 = ____

CWP
a Scott Fetzer company

Mathematics

on-the-job

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Facilitator Manual

I

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CLEVELAND WOOD PRODUCTS

MATHEMATICS ON THE JOB I

OBJECTIVES

Upon completion of the Mathematics on the Job I course, participants will be able to:

- State an increased comfort with math and express increased self-confidence with math skills.
- Read and write whole numbers
- Add, subtract, multiply and divide whole numbers
- Demonstrate the ability to solve word problems involving addition, subtraction, multiplication and division of whole numbers on job-related materials.
- Effectively use calculators to assist with work-related charting and reporting.
- Identify meaning and use of fractions.
- Solve conversions between fractions, decimals and percents.
- Add, subtract, multiply and divide decimals.
- Solve job-related word problems involving decimals.
- Read and interpret gages.
- Determine if a mathematical solution is reasonable.

MATHEMATICS ON THE JOB I
PRE-ASSESSMENT

I. Write the following as whole numbers:

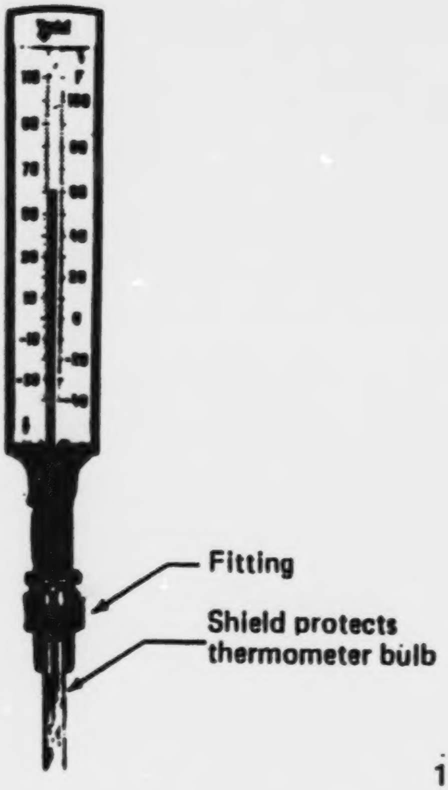
A. Four hundred thousand nine hundred eighty-six

____

B. Seven million eight hundred twenty-one thousand one hundred thirty-three

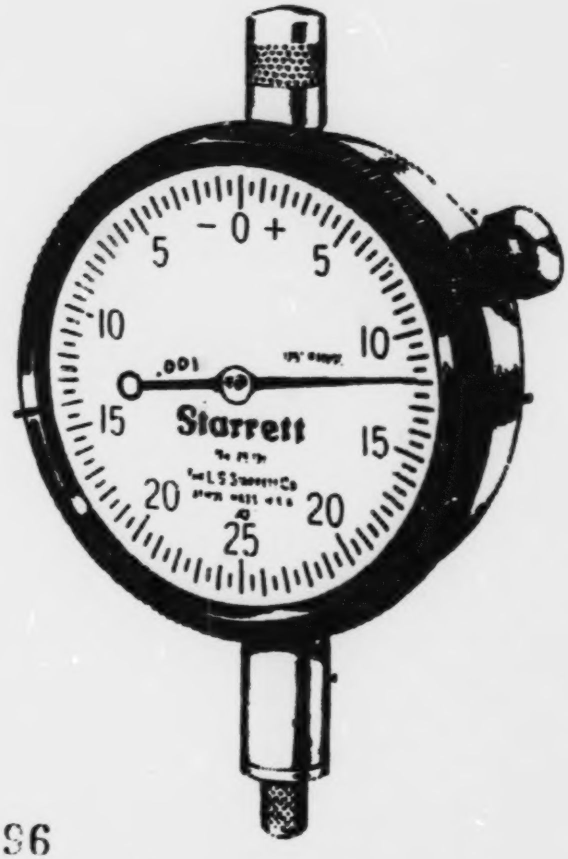
____

II. A. The mercury on this thermometer reads at _______ degrees F.


Fitting
Shield protects thermometer bulb

B. The dial on this indicator points to the number _________.

This is read as _______________.


− 0 +
5
5
10
10
.001
15
Starrett
15
20
25
20

III. Add the following numbers:

A.
415
+ 932

1,347

B.
18,441
59,609
+ 23,484

101,534

IV. Subtract the following numbers:

A.
495
- 23

472

B.
88
- 74

14

V. Solve the following problems:

A. An automatic machine requires servicing after every 300 hours of operation. If the operating-time indicator now reads 193 hours, how many hours remain before the next service is required?

300 hours - 193 hours = 107 hours

B. Add the Pieces Scrapped due to cracked wood at the bearing assembly.

448

SCRAP:

CRACKED WOOD AT BEARING ASSY.	185	101	86	31		45	
HIT OFF(S)							
DEFECT IN WOOD							
NOT LOCKED IN (BRISTLER)	4	1	3	5	5	4	
SET-UP SCRAP		2	7	3	1	5	
TOO SHORT		1			1		
NO PAINT ON ONE SIDE	1		1		2		
INITIALS:						TOTAL SCRAP =	

VI. Multiply the following numbers:

A.
$$\begin{array}{r} 812 \\ \times\ 716 \\ \hline \textbf{581,392} \end{array}$$

B.
$$\begin{array}{r} 8,421 \\ \times\ 18 \\ \hline \textbf{151,578} \end{array}$$

VII. Divide the following, and indicate the remainder, if any.

A. 184 ÷ 23 = **8**

B.
$$\begin{array}{r} \textbf{144}\ \ \textbf{R 29} \\ 64 \overline{)9245} \end{array}$$

VIII. Solve the following problems:

A. Yesterday, 347 boxes of 32 brush assemblies each were packed in your department. How many brush assemblies total were packed?

347 boxes x 32 assemblies = 11,104 brush assemblies

B. Find the average number of pieces reworked due to Bernelled Bearings.

21

PART NUMBER: 661912-003 - RYOBI 12" BALL BEARING BRUSHROLL ASSY.
661912-004 - RYOBI 14" BALL BEARING BRUSHROLL ASSY.
661912-006 - RYOBI 14" BALL BEARING BRUSHROLL ASSY. (4 ROW)

REWORK AND SCRAP REPORT

SHIFT:

	MON	TUES	WED	THURS	FRI	SAT	
REWORK: LIST DATES HERE:	3/6/93	3/7/93	3/8/93	3/9/93	3/10/93	3/11/93	TOTAL
BERNELLED BEARING(S)	21	22	45	29	3	6	
MISSING TUFT(S)	18	19	13	7	4	7	

TOTAL REWORK =

IX. Convert the following:

A. Write the fraction equivalent of .500. **1/2**

B. What is the decimal equivalent of 1/4? **.25**

X. Add the following decimal numbers:

A. .836 + 1.59 + 42.64 = **45.066**

B. 49.23 + .80 + 7.41 = **57.44**

XII. Subtract the following decimal numbers:

A. 18.449 - .671 = **17.778**

B8.224 - .55 = **7.674**

XIII. Solve the following problems using the Rework and Scrap Report given below for 12" Ball Bearing Brushroll Assemblies:

SCRAP:							
CRACKED WOOD AT BEARING ASSY.	185	101	86	31		45	
HIT OFF(S)							
DEFECT IN WOOD							
NOT LOCKED IN (BRISTLER)	4	1	3	5	5	4	
SET-UP SCRAP		2	7	3	1	5	
TOO SHORT		1			1		
NO PAINT ON ONE SIDE	1		1		2		
						TOTAL SCRAP =	
INITIALS:							

A. How many brushroll assemblies were scrapped during the week because they were not locked in? 22

B. If each piece of scrap costs Cleveland Wood Products $4.00, what is the expense for all brushroll assemblies scrapped (for any reason) during this week? $1,976

XIV. Multiply the following decimal numbers:

A. 8.83 x 92.4 = **815.892**

B. .855 x 1.5 = **1.2825**

XV. Divide the following decimal numbers. Carry your answers out to 3 decimal places.

A. 82.4 ÷ .58 = **142.069**

B. 77.51 ÷ 8.9 = **8.709**

XVI. Solve the following problems:

A. You worked 187.5 hours in 2.5 weeks. How many hours did you average per week? __**75 hours**__________

B. You can earn 2 vacation days each month. How many days of vacation would you have at the end of 6.5 months? _____**13 days**____________

XVII. Solve the following word problems.

A. Currently, Tina paints 475 dowels a day. She needs to increase her production by 7%. How many dowels will she need to paint each day?

475 x 1.07 = 508.25 dowels

B. Anna works overtime every week; she is paid time and a half for any hours over 40 each week. Her hourly wage is $12.50. In February of this year, Anna worked 55 hours the first week, 63 hours the second week, 42 hours the third week and 60 hours the last week. How much did Anna earn (before taxes or other deductions were taken out of her check)?

(40 hrs x 12.50) + (15 hrs x 18.75)
+ (40 hrs x 12.50) + (23 hrs x 18.75)
+ (40 hrs x 12.50) + (2 hrs x 18.75)
+ (40 hrs x 12.50) + (20 hrs x 18.75)

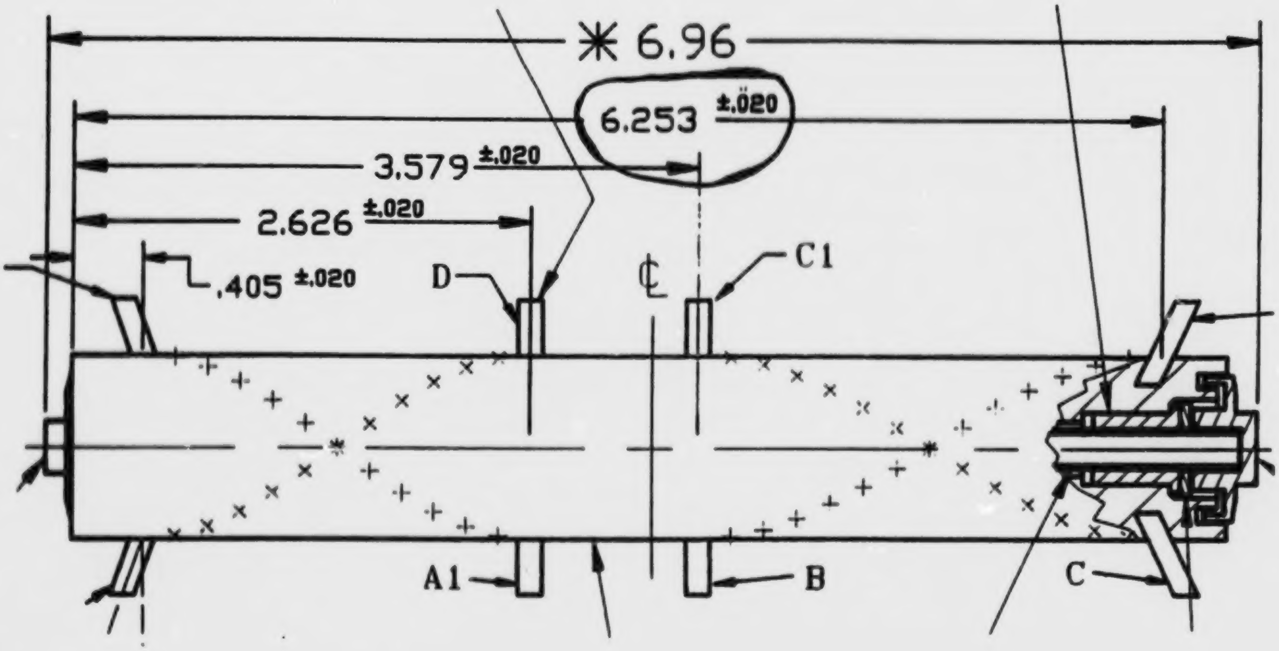
(160 hrs x 12.50) + (60 hrs x 18.75) = $3,125.00

C. You accrue sick time at the rate of .5 days per every 2 months worked. At the end of one year, how much sick time have you accrued?

(12 months / 2) x .5 = 3 days

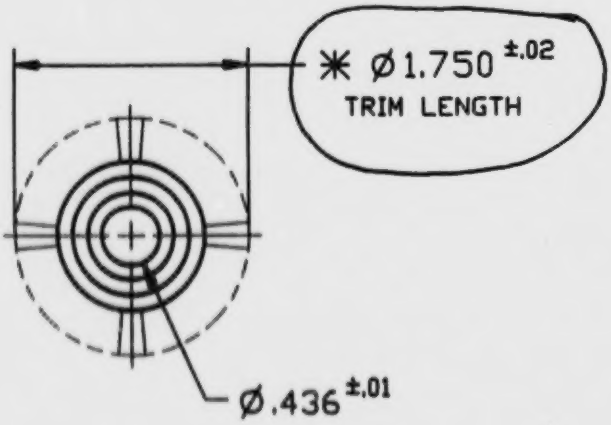
D. Find the upper (+) tolerance on the circled length.

6.273


✱ 6.96
6.253 ±.020
3.579 ±.020
2.626 ±.020
.405 ±.020
D
℄
C1
A1
B
C

E. What is the lower (-) tolerance for the circled dimension?

1.730


✱ Ø1.750 ±.02
TRIM LENGTH
Ø.436 ±.01

CLEVELAND WOOD PRODUCTS

MATHEMATICS ON THE JOB I

OBJECTIVES

SESSION I

- State an increased comfort with math and express increased self-confidence with math skills.

MATHEMATICS ON THE JOB I
SESSION 1

How to Study Math

Introduction

Introduce self and course. Have students introduce themselves. Pass out any books or materials needed.

Why are we here? (Ask students what they hope to get out of the course.)

Here's what we hope to provide:

> An opportunity for you to learn/review math skills necessary to effectively perform your job.
>
> An increased understanding of how important math is to your job, and to our technological society.
>
> The training and practice necessary to help you feel more comfortable with math and to increase your self-confidence with your math skills.

Exercise

Have each student write down a personal math goal for himself or herself. Students can choose from those above or write their own. This is not to be collected or shared with the class--it's for the student's personal use.

The Importance of a Positive Attitude

We've all heard the term "Math Anxiety" and many of us think it applies to us. What are some reasons why people are "afraid" of math? (List responses of class on board.)

Some Reasons for Math Anxiety

> **Past Conditioning** - We were told that we weren't good at math or we were "tracked" in high school and assumed we didn't need or couldn't learn math.

The Importance of a Positive Attitude (cont'd)

Can't see the need for math - Often when we're younger, we fail to see the importance of math to our future or our daily work lives. Now that we have jobs that require us to use math, it becomes much more relevant.

We believe myths about math

1. Math is hard and complicated to learn.

   Math is different from learning vocabulary or how to read a blueprint. But math isn't as mysterious or complicated as we may have been led to believe. Everyone in this room has the ability to learn math.

2. Math is for eggheads.

   Everyone needs and can learn math. And you don't necessarily have to have a "mathematical mind" to understand math. Sure, the eggheads may need and use theory more, but math skills and reasoning are useful and learnable by people at many different levels.

Not enough experience using math

Maybe until recently, you never had much need for math. So, you probably don't have a lot of math experience. This class, will, of course, provide experience. And as you practice math skills, you'll feel more comfortable with your math abilities.

Whatever the reasons for your math anxiety, it's time to change and replace those old attitudes with a new positive attitude toward math. "I know I can!" is the new attitude we want to develop.

MATHEMATICS ON THE JOB I
SESSION 1

The Importance of a Positive Attitude (cont'd)

What can you do to get and keep a positive attitude?

Believe in yourself.

Tell yourself you know you can do it!

You can use affirmations/positive statements to help you in this area. Come up with a positive statement about your ability to learn math. Repeat this to yourself several times daily. Also, whenever negative thinking creeps in, stop, and replace those negative thoughts with your new positive statement.

Stay relaxed.

If you find yourself getting frustrated, take a break, mental or physical, for a few minutes. Then approach the problem or concept again.

Get rid of "all-or-nothing," have-to-be-perfect attitudes.

Yes, the right answer is important in math, but you're learning. So, give yourself credit for what you do right!

Having a positive attitude does not mean that math will come instantly or easily. You still may struggle and run into difficulties, but if you keep your positive attitude, you can persevere and you'll win in the end!

Exercise

Have the students write a positive 1-sentence affirmation about their ability to learn math. This is what they should repeat to themselves daily and when they have difficulties.

Example: I know I have the ability to solve math problems.

MATHEMATICS ON THE JOB I
SESSION 1

What to Expect

Math is a process.

Much like learning to run a machine. Did you go on the job and operate the machine like a pro the first time you ran it? Probably not. It took time, practice and experience before you became an expert. Math is very much the same. You'll need to work a lot of problems before you'll be an expert. But you will be one!

Math is learned by doing, not just observing.

What if you read every book about bicycle riding there was? What if you subscribed to every bicycle magazine published, but you never got on a bike? Do you think you would know how to ride a bike? Of course not! You would know an awfully lot about how to ride one, but you, yourself, wouldn't be able to actually do it. Math is similar to bike-riding. You can watch the instructor work problems, you can follow each step along the way, but you won't learn math until you actually work the problems yourself.

In this class, there will be lots of opportunities to practice working problems. If you need more practice, there are software programs available in the learning lab and extra problem sets can be obtained from the instructor. Practice as much as you need to, not as little as you can get away with. In the case of math -- Practice makes Improvement!

Everyone learns math at different rates and approaches problems a little differently.

It's good to interact with others, in fact, it's encouraged in this class. But don't compare yourself unfavorably to others, thinking that you're "slow" if you don't come up with the answer as quickly (perhaps you're just more thorough) or that you're "wrong" because your approach to a problem is a little different. Remember, everyone has his or her own way of doing things.

MATHEMATICS ON THE JOB I
SESSION 1

What's Expected

To succeed in math, you'll need to do the following:

Attend classes.

Missing a class automatically puts you behind since math builds on skills. If you have to miss a class, contact the instructor. He or she can fill you in on what you'll be missing, and direct you to appropriate exercises and software to help you catch up quickly.

Participate in class.

- Ask questions when you're lost. (Chances are if you're lost, so are others.)
- Actively participate in class and team activities. They're meant to be a fun way to practice and improve skills.
- Complete in-class assignments. Use the time given to work the math problems assigned. Since the instructor's there, if you run into problems, you can easily ask for help.

Listen actively and take effective notes.

- Try to follow what the instructor's saying even if you can't make sense of it all right away. (And don't be shy about asking questions.)
- Take neat, meaningful notes. This will help you to make sense of what was discussed later on.

Listening and notetaking will be covered in more detail later.

Practice, practice, practice.

As mentioned earlier, this is the best way to learn math.

MATHEMATICS ON THE JOB!
SESSION 1

Class Discussion

What are student's expectations? What do they think of what's expected of them?

Math Notetaking and Study Tips

Notetaking Tips

Tip # 1: Be neat.

In math, neatness counts!! You need to be able to follow the problem-solving process, both in your notes and when working problems.

Tip # 2: Write down the problem as the instructor works it out on the board and write down your explanation of the steps in the process.

This will help you to understand the process and your notes will be a lot more useful because they won't just be a bunch of numbers.

Example

Adding 2 numbers

Problem	Process
142	1. Add numbers in Ones place.
+ 14	2. Add numbers in Ten's place.
	3. Add numbers in Hundred's place. (If there isn't a number in a place, treat as a 0.)
156	

Tip # 3: Copy down all definitions and principles.

It's important that you know and understand these. They'll be used over and over again in class and for explanations.

MATHEMATICS ON THE JOB I
SESSION 1

Math Notetaking and Study Tips (cont'd)

Tips for Reviewing Your Notes

Tip # 4: **Rework the example problems.**

Before you go on to the uncharted territory of practice problems, be sure you can work the known territory of the example problems in your notes. If you get stuck on the example problem, you can ask the instructor for clarification. This will save you time and frustration when you're out there on your own with the practice problems.

Study Tips

Tip # 5: **Make sure you can explain the process for working different types of problems.**

Explain it out loud, to yourself, to someone else, to your cat

and/or

Write down a process to follow when working out problems of a certain type. Pretend you're explaining it to someone who doesn't know it.

Tip # 6: **Work all practice problems as completely as you can.**

Don't stop if you get a wrong answer to one and aren't sure where you went wrong, or if you notice the problems are getting more difficult. If you've gone over a problem several times and can't pinpoint your error, mark it and go on to the next one. Then come back to it. Or make a note to ask the instructor about it in the next class. When receiving an explanation, make sure you understand what the error was so you can avoid it in the future.

MATHEMATICS ON THE JOB I
SESSION 1

Solving Math Problems

Below is a general procedure to follow when solving math problems.

1. **Don't be afraid of the problem** (especially if it looks complicated). Go ahead, give it your best shot. Even if you don't get the right answer, you'll learn a lot about the math process.

2. **Read the problem carefully.** Determine what you're given and what you're supposed to find.

3. **Refer to your process for solving the type of problem you're working on.** Follow the process, step by step. Be sure to be neat.

4. **Recheck your work.** (Neatness makes this easier.) Many students skip this step, but those that recheck learn more. (They see where they make their mistakes.) They also gain confidence more quickly. (They take the opportunity to learn from and correct their mistakes.)

5. **Ask yourself if the answer is reasonable.** Does it make sense, given the information you had to work with? Or does is seem way off? If it doesn't seem right, go back to Step 4, one more time.

Remember: You have the ability to learn and solve math problems. If you use the tips and techniques given in this module, you'll be on your way to math success.

CLEVELAND WOOD PRODUCTS

MATHEMATICS ON THE JOB I

OBJECTIVES

SESSION 2

- Read and write whole numbers
- Add and subtract whole numbers

MATHEMATICS ON THE JOB I
SESSION 2

Reading and Writing Whole Numbers

Introduction

Introduce the section on reading and writing whole numbers. Mention that we'll be starting at the beginning reviewing what whole numbers are, the decimal system and how to read and write whole numbers. Also mention that each section, including this one, will start out with definitions. The first page contains the words to be defined. You'll give them the definition and they need to take notes on the definition. Remind them that it's most advantageous to rewrite the definition in their own words.

Definitions

Before we can begin talking about how to read and write whole numbers, there are some definitions we need to be familiar with:

Digit - the set of ten symbols used to represent the whole numbers from 0-9.

Decimal System - a number system based on 10. This is the number system we use, probably because we have 10 fingers.

Place Value - the value that a digit takes on based on what position it's in. For instance, 2 means 2, but in 25, the 2 represents twenty.

Whole Number - All numbers in the number system that are not fractions. Whole numbers include the positive or counting numbers (1,2,3,4,5....), zero, and the negative numbers (-1,-2,-3,-4,-5...). In this class, we'll only be dealing with the positive numbers and zero.

MATHEMATICS ON THE JOB I
SESSION 2

What is a number?

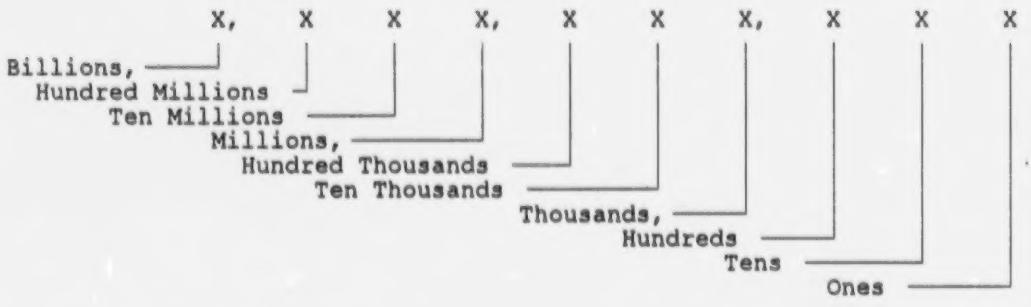
A number is a concept. Numbers are really ideas in someone's head. In order to express that idea of 4 or 2 or 3, we use numerals so that everyone can get the same idea. If I asked you to picture 4 dowels, everyone would picture the same number of dowels. Some people might picture them all lined up in a row, some might picture 2 on top, 2 on the bottom, etc. but everyone would see the same value of 4.

The Decimal System

Any number system is made up of symbols that express the idea of numbers. Our number system is based on 10. That means we have 10 symbols (1-9 and 0), to express numerals. Any value greater than 9 must be represented by 2 numbers such as 10 or 11. This makes the value of the digit significant and also makes the position of each digit significant. The position of the digit and what it represents is called place value.

Here are the place values in the decimal system up to a billion.

The Decimal System


X, X X X, X X X, X X X
Billions,
Hundred Millions
Ten Millions
Millions,
Hundred Thousands
Ten Thousands
Thousands,
Hundreds
Tens
Ones

The Decimal System (cont'd)

Use the following number as an example to show how place values are indicated in a number:

6,827,439,012

means

6	billions,
8	hundred millions
2	ten millions
7	millions,
4	hundred thousands
3	ten thousands
9	thousands,
0	hundreds
1	tens
2	ones

Class Activity

Have participants complete the class activity. The two numbers should be written out as they would be said.

Given:	**Read/Write as:**
1,756,843	One million, seven hundred fifty-six thousand, eight hundred forty-three.
320,472,082,126	Three hundred twenty billion, four hundred seventy-two million, eighty-two thousand, one hundred twenty-six.

MATHEMATICS ON THE JOB I
SESSION 2

Here are some clues to help you with writing numbers:

1. Whenever you hear one of the following words, you should immediately write a comma:

   thousand million billion

2. Each "group" of numbers after a comma must have three digits. If you only hear two numbers, the missing one must be a zero.

   Zero is used as a place marker when there are no hundreds or tens or millions, for example. It's a very common error to leave out this zero.

PRACTICE

Are all the places accounted for in these numbers?

A. 24, 31, 295

B. 347, 219, 739

C. 1, 856, 23

D. 96, 45, 16

Did you notice that A, C, and D are wrong? To fix the incorrect numbers, put a zero immediately after the comma if there are only two numbers in that group.

Rewrite the numbers correctly:

A. 24,031,295

C. 1,856,023

D. 96,045,016

MATHEMATICS ON THE JOB I
SESSION 2

Class Activity

For the next section, read at least eight of the following numbers in words, and have the students write the numerals. Stop to check their work after every two numbers so that the same errors are not made again and again. Do at least eight examples, and more if it seems necessary.

	Answer:	**Read:**
A.	1,233,586	One million, two hundred thirty-three thousand, five hundred eighty-six
B.	3,984,602,752	Three billion, nine hundred eight-four million, six hundred two thousand, seven hundred fifty-two

Stop here to check work.

A.	64,056	Sixty-four thousand, fifty-six
B.	132,019,875	One hundred thirty-two million, nineteen thousand, eight hundred seventy-five

Stop here to check work.

A.	93,276	Ninety-three thousand, two hundred seventy-six
B.	6,237,001,884	Six billion, two hundred thirty-seven million, one thousand, eight hundred eighty-four

Stop here to check work.

A.	56,392	Fifty-six thousand, three hundred ninety-two
B.	239,100,042	Two hundred thirty-nine million, one hundred thousand, forty-two

Stop here to check work.

Commas

To make big numbers like the ones we've been working with easier to read, we separate groups of 3 digits using commas. For instance, we put a comma after the thousands place, before the hundreds place like 4,035. We also put a comma after the millions place, before the hundred thousands place like 42,345,607.

Ask participants to put commas in the 2 numbers on the handout.

Answers:

125,974

23,834,688

Practice

If time in class, have participants complete the practice page included on page 2-8. If there's not time, assign it as homework.

Write the following as whole numbers:

1. One hundred eighty-nine thousand six hundred forty eight

____

2. Fifty-seven thousand one hundred six

____

3. Three hundred fifty-two

____

MATHEMATICS ON THE JOB I
SESSION 2

4. Four hundred sixty-seven million, one hundred twenty thousand eight hundred fifteen

____

Put commas in the following numbers:

5. 3 4, 5 6 9

6. 5, 7 8 9, 0 2 1

7. 4 3, 2 9 3, 4 1 5, 6 6 3

MATHEMATICS ON THE JOB I
SESSION 2

Adding and Subtracting Whole Numbers

Introduction

Introduce the section on adding and subtracting whole numbers. We'll be talking about what addition and subtraction are, the addition and subtraction processes, and how to carry when adding and borrow when subtracting. We'll also take a look at two important principles of addition.

What is addition?

In order to illustrate what addition is, I'm going to use a money example. Let's say I had 8 dollars and someone gave me 3 more. I'd want to know how much I had altogether. Well, one way to find out would be to count them all. Based on my counting, I would know that 8 and 3 combined together make 11. (Write 8 + 3 = 11 on board.) Addition basically is just the combining of 2 or more values together to make a new or different value.

Definitions

This brings us to our addition definitions. We've just defined what **addition** is; the process of combining 2 or more numbers to get a value. Addition is also considered the first basic operation in math.

Let's take a look at some other definitions we'll need when we talk about addition.

Addends are the numbers being added. 8 and 3 in my example.

Plus sign (+) is used to indicate that addition is the operation to be performed.

Sum - the result (or answer) of adding two or more numbers together. 11 was the sum in my example.

MATHEMATICS ON THE JOB I
SESSION 2

Simple Addition

When we're adding single digit numbers together like 8 and 3, that's called simple addition. For instance, we probably know that 7 + 5 = 12 and that 4 + 2 = 6. We most likely learned these simple addition facts a long time ago and know them by memory.

Class Activity

Complete the class activity on page 2-11. It's all simple addition, so it should be just a quick review for them to help them get into the swing of things.

Adding Numbers With More Than 1 Digit

Let's talk about the process we use when adding numbers with more than 1 digit. Once again, I'll use money to illustrate my point. Let's say I have $34. And I want to add $63 more to it. I would now need to figure out how much money I have all together. First, I'd count how many $1's I had. Then, I'd count how many $10's I had. I should get a total of $97.

Let's take a look at how you'd do this problem if you didn't conveniently have some money to count.

Write

$$\begin{array}{r} 34 \\ +\ 63 \end{array}$$

on board.

First, you'd arrange the numbers in columns. Then, you'd add the numbers in the Ones column. You always start there first. In this case 3 and 4 is 7. (Write the 7 below the Ones column.) Then, you'd add the numbers in the Tens column. Here 3 and 6 is 9. (Write the 9 below the Tens column.) So, we come up with our answer of 97.

Carrying

Let's see how we use carrying in addition.

Write on board:

$$\begin{array}{r} 16 \\ +\ 28 \\ \hline \end{array}$$

Once again, you arrange the numbers in columns. Then you start with the Ones column and add the numbers in that column. If the number is greater than 10, as in our example where 6 + 8 = 14, then you write the number of units in the Ones column. (Write the 4 in the Ones column.) And you carry over the number of Tens, in this case 1. (Write a small 1 above the 1 in 16.) Then, you add the numbers in the Tens column including the number you just carried. In this case we're adding 1 + 1 + 2 to get 4. So, that's how we come up with our answer of 44.

Let's look at one more example:

$$\begin{array}{r} 33 \\ +\ 79 \\ \hline 112 \end{array}$$

(Go over this example, giving whatever detail is needed by the class as explanation.)

Mention that you also carry from the Tens to the Hundreds column, from the Hundreds column to the Thousands column, etc.

If the class seems to understand carrying, move on to the class activities. If not, take questions and illustrate with a few more examples.

MATHEMATICS ON THE JOB I
SESSION 2

Class Activity

Have the class complete the 2 class activities on pages 2-14 and 2-15. Page 2-14 requires adding two 2-digit numbers together with carrying. Page 2-14 is a bit more challenging - adding 3 multi-digit numbers together and carrying across more than one column in many instances.

ADDING AND SUBTRACTING WHOLE NUMBERS
(Page 2-14)
Class Activity

83
+ 78
161

49
+ 62
111

34
+ 18
52

56
+ 87
143

95
+ 29
124

47
+ 85
132

(Page 2-15)
Class Activity

3,457
6,308
+ 1,232
10,997

49,562
679
+ 8,516
58,757

17,022
4,656
+ 21,438
43,116

856,917
2,125,487
+ 522,845
3,505,249

Addition Properties

Next, we're going to talk about 2 important addition principles. These principles can help us to add numbers together a little easier. The first principle we're going to talk about is the **commutative property** of addition.

The commutative property says that you can add numbers in any order and still get the same sum. In other words, you can rearrange the order of the numbers before you add them, and you'll still get the same answer. Let's take a look at an example:

$$2 + 3 + 4 = 9$$

And, if we change the order to

$3 + 4 + 2$, that still equals 9.

In fact, the commutative property means that

$4 + 3 + 2 = 9$, and
$3 + 2 + 4 = 9$, and
$2 + 4 + 3 = 9$, and
$4 + 2 + 3 = 9$ also.

One way we can use the commutative property is when we're adding a lot of numbers together. We can change the order, so that we can add easier combinations of numbers together. For instance, 1 + 7 + 2 + 3 + 9. We might want to add the 1 + 9 and the 7 + 3 for a total of 20, then add the 2, so we easily come up with the answer of 22.

Ask if there are any questions. If the class has questions or seems confused, illustrate the commutative property with a few more examples.

The second important principle of addition is the associative property. The associative property allows us to group numbers that are being added together in any way and still get the same sum. Let's look at an example:

9 + 4 + 2 + 1 + 6 = 22

According to the associative property, we could group these
numbers like this:

(9 + 4) + (2 + 1) + 6 and still get 22. (Point out that 13 + 3 + 6 = 22.)

We could also group these numbers like this:

(9 + 4 + 2) + (1 + 6) and we'd still get 22. (15 + 7).

Or we could group these numbers like:

9 + (4 + 2) + (1 + 6) and we'll find that:
9 + 6 + 7 = 22.

Addition Properties (cont.)

Once again, we can use the associative property when adding numbers to help us group numbers together into easier combinations. For instance, 8 + 5 + 4 + 1. We can group these numbers as 8 + (5 + 4) + 1 and quickly get 8 + 9 + 1 = 18. We can also combine both the commutative and associative properties to help us add numbers together. For example:

8 + 5 + 9 + 2 + 3 + 6

can be re-ordered and grouped as

5 + (2 + 3) + (6 + 9) + 8 = 33 (Quickly and easily, that's 5 + 5 + 15 + 8 = 33.)

Some people do this reordering and grouping in their heads when adding numbers. That's OK as long as you know you can keep track of the numbers. Some people may need to write down or note the new order and groupings and that's OK, too, as long as the written notes are neat and readable.

Ask if there are any questions about either of these properties or how to use them alone or in combination. If there are, or if the class doesn't seem clear, take questions and use some more examples to illustrate them.

Class Activity

Have the class complete the activity on the commutative and associative properties on page 2-17.

MATHEMATICS ON THE JOB I
SESSION 2

ADDING AND SUBTRACTING WHOLE NUMBERS
(Page 2-17)

Class Activity

1. List all the ways you can think of to change the order of the numbers below according to the commutative property.

   2 + 3 + 5

   2 + 5 + 3
   3 + 2 + 5
   3 + 5 + 2
   5 + 3 + 2
   5 + 2 + 3

2. Are the following mathematical statements true or false?

   a. 8 + 14 + 26 + 7 = 7 + 14 + 26 + 8 **T**

   b. 7 + 2 + 5 = 7 + 5 **F**

3. List 3 different ways to group the numbers below according to the associative property.

   89 + 32 + 14 + 9

   (89 + 32) + (14 + 9)
   (89 + 32 + 14) + 9
   (89 + 32) + 14 + 9
   89 + 32 + (14 + 9)
   89 + (32 + 14 + 9) etc.

4. Are the following mathematical statements true or false?

   a. (3 + 4) + 2 = (3 + 4) + 3 F

   b. 14 + (1 + 6) + (8 + 2 + 3) =

   (14 + 1) + 6 + 8 + (2 + 3) T

Subtraction

Next, we're going to talk about the second basic mathematical operation, subtraction. First, we'll find out just what subtraction is by considering an example. Suppose we had 6 screws and we used 4 of them to install a light switch plate. How many would we have left? 2, of course. As you can see from this example, subtraction is the taking away of one value from another. In this case, 4 was taken away from 6. Subtraction is the opposite of addition.

Definitions

Now, that we've defined what subtraction is, let's learn some other subtraction definitions that it will be good to know:

Difference - The result (in other words, the answer) of subtracting one number from another. In our example, the difference was 2.

Minuend - The number being subtracted or taken away from, usually (although not always) the first number in a subtraction problem. In our example, the minuend was 6.

Subtraction Sign (-) - indicates subtraction is the operation to be performed.

Important Fact: You **must** keep the subtraction sign with the number that follows it. If you do this, then you can change the order and grouping of numbers just as for addition.

Subtrahend - The number being subtracted or taken away, usually the second number in a subtraction problem. The subtrahend in our example was 4.

Class Activity

Let's take a few minutes to practice some of our basic subtraction skills. The class activity on page 2-19 actually combines simple addition and simple subtraction. Let's take a few minutes to complete it. (Have students complete this class activity.)

ADDING AND SUBTRACTING WHOLE NUMBERS
(Page 2-19)

Class Activity

$$\begin{array}{r} 3 \\ +\ 2 \\ -\ 4 \\ +\ 1 \\ \hline 2 \end{array} \qquad\qquad \begin{array}{r} 2 \\ -\ 2 \\ +\ 6 \\ -\ 3 \\ \hline 3 \end{array}$$

$$\begin{array}{r} 8 \\ +\ 7 \\ -\ 3 \\ -\ 4 \\ \hline 8 \end{array} \qquad\qquad \begin{array}{r} 5 \\ -\ 2 \\ -\ 1 \\ +\ 4 \\ \hline 6 \end{array}$$

Subtracting Numbers With More Than 1 Digit

Let's look at what we do when we subtract numbers with more than one digit. Write on board:

$$\begin{array}{r} 385 \\ -\ 251 \\ \hline \end{array}$$

Just as in addition, we first arrange the numbers in columns. Then, we start with the Ones column: We subtract the bottom number from the top number. In this case, 5 - 1 = 4. (Write the number 4 under the Ones column.) Then, we subtract the bottom number from the top number in the Tens column. Here, we'll have 8 - 5 = 3 (Write 3 under the Tens column.) Then, we move to the hundreds column and once again subtract. This time 3 - 2 = 1. (Write 1 under the 100's column.) So, the difference between 385 and 251, is 134.

Borrowing

What if we have a situation where the bottom digit is larger than the top digit? Let's take a look at what we'd do there. We'll go back to the money for just a minute. Suppose I have $35. But, let's say I owed you $18. I'd have to take that away from 3 $Tens and 5 $Ones. But I have a problem, I don't have 8 $Ones, I only have 5 $Ones. You tell me to just take one of my $Tens and replace with 10 $Ones. So, I do that. Now I'd have 15 $Ones in all. I give you 8. And, I'd be left with 7. Now, since I owe you $18, I'd also need to give you a $10 from my $Tens pile. I'd have 2 left so it's no problem. You get 1 $10 and I'm left with a $10. Altogether then, I'm left with $17. The process of replacing a ten with 10 Ones is called borrowing. It's the opposite of carrying in addition.

Now, let's do this same problem on the board. Write on board:

$$\begin{array}{r} 35 \\ -\ 18 \\ \hline \end{array}$$

Borrowing (cont'd)

Of course we arrange the numbers in columns. Then, we go to subtract the numbers in the Ones column. But, we find that we can't take away 8 from 5. So, we need to borrow from the Tens column. What we do is take 1 away from the 3, cross out the 3 and write in a 2. Then, write a small 1 next to the 5. Now, we can complete our subtraction in the Ones column. 15 - 8 = 7. (Write 7 under the Ones column.) Next, we go to the Tens column and subtract. We use the reduced value of 2 for the top digit. 2 - 1 = 1. (Write 1 under the Tens column.) So, once again, we've come up with our answer of 17.

Let's take a look at one more example:

$$\begin{array}{r} 356 \\ -\ 189 \\ \hline \end{array}$$

(Go over this example, giving whatever detail is needed by the class as explanation.)

If the class seems to understand borrowing, move on to the class activities. If not, take questions and illustrate with a few more examples.

Class Activity

Have the class complete the class activity on page 2-22, subtraction problems with borrowing.

ADDING AND SUBTRACTING WHOLE NUMBERS
(Page 2-22)

Class Activity

$$\begin{array}{r} 46 \\ -\ 29 \\ \hline 17 \end{array} \qquad \begin{array}{r} 513 \\ -\ 225 \\ \hline 288 \end{array} \qquad \begin{array}{r} 87 \\ -\ 58 \\ \hline 29 \end{array}$$

$$\begin{array}{r} 222 \\ -\ 57 \\ \hline 165 \end{array} \qquad \begin{array}{r} 4{,}672 \\ -\ 2{,}584 \\ \hline 2{,}088 \end{array}$$

Game

After everyone has completed the class activity, have the class play the game, The Answer is Right!

Divide the class up into groups of 3 people each. Each group will get a sheet of addition/subtraction problems - 9 all together. As a group, they must solve these problems correctly and quickly. When they've got all the answers, they send a runner up to the instructor to check the answers. The instructor marks any that are incorrect and sends the runner back to the group to get them corrected. The group corrects any problems and sends the runner up again. The first group to answer all the problems correctly is the winner!!

Allow 5 minutes to choose a runner and discuss strategy. Then, pass out problem sheets, have them turn over at the same time and begin!

MATH ON THE JOB I
SESSION 2

THE ANSWER IS RIGHT!

Problem Sheet

$$\begin{array}{r} 35 \\ + 47 \\ \hline 82 \end{array} \qquad \begin{array}{r} 637 \\ - 256 \\ \hline 381 \end{array} \qquad \begin{array}{r} 90{,}972 \\ + 1{,}756 \\ \hline 92{,}728 \end{array}$$

$$\begin{array}{r} 906 \\ - 81 \\ \hline 825 \end{array} \qquad \begin{array}{r} 42 \\ 120 \\ + 53 \\ \hline 215 \end{array} \qquad \begin{array}{r} 102{,}345 \\ + 453{,}197 \\ \hline 555{,}542 \end{array}$$

$$\begin{array}{r} 1{,}178 \\ - 645 \\ \hline 533 \end{array} \qquad \begin{array}{r} 580 \\ - 14 \\ \hline 566 \end{array} \qquad \begin{array}{r} 13 \\ + 1{,}345 \\ \hline 1{,}358 \end{array}$$

CLEVELAND WOOD PRODUCTS

MATHEMATICS ON THE JOB I

OBJECTIVES

SESSION 3

- **Demonstrate the ability to solve word problems involving addition and subtraction of whole numbers on job-related materials.**
- **Multiply and divide whole numbers.**

MATHEMATICS ON THE JOB I
SESSION 3

Solving Addition and Subtraction Word Problems

Introduction

Introduce the section on solving addition and subtraction word problems. Mention that we'll be starting slowly with some simple word problems and progressing to more challenging word problems as the class progresses. We'll look, first, at a general strategy for solving word problems. And we'll also take a look at some different strategies that can be used.

5 Steps to Solve Word Problems

First, let's look at our general strategy for solving word problems. There are 5 steps that we need to follow when solving word problems:

1. **Determine what the question is.**
2. **Eliminate any extra information** given in the problem that you do not need to solve it.
3. **Identify what mathematical operation or operations to use.**
4. **Perform the math** to solve the problem. Write down your answer and check your work.
5. **Check** to make sure your answer is reasonable.

Remember that solving word problems easily and accurately is a process, one that requires lots of practice, which we'll get in this class. But you probably solve word problems every day on your job, and you may not even realize it. Every time you have to figure out lengths of something to cut or how many good parts you produced for the day, you're setting up and solving a word problem.

Although we're going to start out simple here, it's important to go through the 5-step process, even if you can solve the problem in your head or with less steps. By practicing this process now, it will be second nature when we get to tougher, more complicated word problems later in the course.

It will also help us to identify different types of word problems. Today, we'll only be dealing with addition and subtraction word problems. But as we progress to multiplication and division word problems, you'll need to distinguish what type of word problem it is and what math operations you'll need to perform. The 5-step process can help you.

Example Problem

Now, let's look at an example word problem, and apply the 5-step process to it.

Here's our word problem:

Gary produced 512 Douglas rings today and 482 Douglas rings yesterday. The boring machine was down both days. How many Douglas rings did he produce all together for both days?

Step 1: **The question is:** How many rings were produced during the 2 days?

Step 2: **The extra information is:** The boring machine was down both days.

Step 3: **The math operation I'll use to solve the problem is:** Addition. To determine the operation to use, you want to consider what the problem is asking. But, you also can identify some key words that can give you some clue as to what you need to do to the numbers to arrive at a solution. In this case, our keywords indicating addition were **and** and **all together**.

Step 4: **The math:** 512 + 482 = 994 rings

Step 5: **Is my answer reasonable?** Yes, in this case because 994 is greater than both 512 and 482. This makes sense since we were looking for a total for both days.

MATHEMATICS ON THE JOB I
SESSION 3

Addition Keywords

As I mentioned when discussing Step 3, many times we can use keywords in the word problem to decide what operation we'll need to use to solve the problem. On page 3-3 is a list of addition keywords.

Addition Word Problem

Let's look at another example, an addition word problem, and let's solve it using our 5-step process. (As you go through the problem, stop at each step and ask the class for the answer to each question.)

Maria, who's been with the company for 15 years, increased her average production by 200 pieces per week. Her previous production was 1800 pieces per week. How many pieces per week does she produce now?

Step 1: **The question is:** How many pieces per week are being produced after the increase?

Step 2: **The extra information is:** Maria's 15 years with the company is irrelevant. Not every number in a word problem will help you with its solution.

Step 3: **The math operation I'll use to solve the problem is:** Addition. The keyword is **increased**.

Step 4: **The math:** 200 + 1,800 = 2,000 pieces per week.

Step 5: **Is my answer reasonable?** Yes, because 2,000 is greater than 1,800, the previous value. If we had gotten, say, 1,600, this would not have been reasonable because 1,600 would have been less than the original 1,800 and would not have indicated an increase.

Subtraction Keywords

Sometimes, we need to subtract when solving word problems. Just as for addition, we can sometimes cue in on keywords to help us identify subtraction as the operation we'll need to perform. On page 3-5, you have a list of subtraction keywords.

Subtraction Word Problem

Now let's take a look at a subtraction word problem and practice our 5-step method of solving it. (Once again, involve the class in going through the 5 steps of solving the problem.)

Gary isn't feeling well and his production is down from its normal level. He produced 512 brushes today and 482 brushes yesterday. How many fewer brushes did he produce yesterday than today?

Subtraction Word Problem

Step 1: **The question is:** How many fewer brushes were produced yesterday?

Step 2: **The extra information is:** Gary isn't feeling well.

Step 3: **The math operation I'll use to solve the problem is:** Subtraction. The keywords are **fewer than**. Note that they are separated by some words.

Step 4: **The math:** 512 - 482 = 30 brushes.

Step 5: **Is my answer reasonable?** Yes, because 30 is less than 512 and 482. And 30 is the difference between these two numbers, which is what we're looking for.

Be Careful With Keywords

We've been looking at keywords to help us determine what math operation to use. But as was mentioned earlier, we have to take the whole problem into consideration, because relying on keywords only can sometimes lead us down the path to the wrong solution. Let's take a look at an example of this. (Be sure to involve the class in solving this problem as well.)

Maria increased production on her center boring machine by 200 dowels per week. She's now producing 1800 dowels per week. As a result, she got a $500 bonus. How many dowels per week was she producing before?

Step 1: **The question is:** How many dowels per week were being produced **before** the increase?

Step 2: **The extra information is:** She got a $500 bonus.

Be Careful With Keywords (cont'd)

Step 3: **The math operation I'll use to solve the problem is:** Subtraction. However, the keyword is **increased,** which would indicate addition at first glance. But after considering the problem, we realize that we're looking for the number of dowels per week **before** the increase. So, we need to subtract the increase from the number of dowels produced now.

Step 4: **The math:** 1,800 - 200 = 1,600 dowels per week.

Step 5: **Is my answer reasonable?** Yes, because 1,600 is less than 1,800, the current value. If we had added and gotten 2,000, this wouldn't have made sense because it would have meant that Maria was producing more dowels before the increase.

Additional Strategies For Solving Word Problems

Let's take a look at some additional strategies that can be useful for solving word problems. I'll briefly describe each one and then we'll look at an example of each strategy.

Restate the problem in your own words. Sometimes, it's helpful to talk through or rewrite the problem in your words. That way you may be able to better figure out what they're asking for or what the necessary information is. It can also help you sift past irrelevant information.

Draw pictures or diagrams. Drawing a simple picture or a diagram can help you look at all the information you've been given at a glance and can help you decide how to proceed. Drawing pictures or diagrams helps you to decide what math operation to use and how to set up the math.

Write number sentences. If you write a sentence that's a combination of numbers and words, it's easier to see what math operation you should use and once again how to set up the math. Writing number sentences is a way to make sense of the problem without using a lot of words.

Restate Problem Example

(Be sure to have the class identify each step of the 5-step process. Involve participants as much as possible.)

John Smith is filling out a rework and scrap report for rug renovator brushes. 19 pieces were reworked this week due to missing tufts. On Monday, there were 4 reworked parts, on Tuesday 7 and on Thursday 2. John has been training a new person, and didn't get his afternoon break all week. How many pieces were reworked on Friday?

Let's restate the problem. The total number of reworked pieces is 19. Pieces were reworked on several days, and we need to find how many were done on Friday.

Step 1: **The question is:** How many pieces were reworked on Friday?

Step 2: **The extra information is:** He hasn't gotten a break all week.

Step 3: **The math operation I'll use to solve the problem is:** Subtraction. We need to know the number for Friday, and we have the total for the week.

Step 4: **The math:** 19 - 4 - 7 - 2 = 6

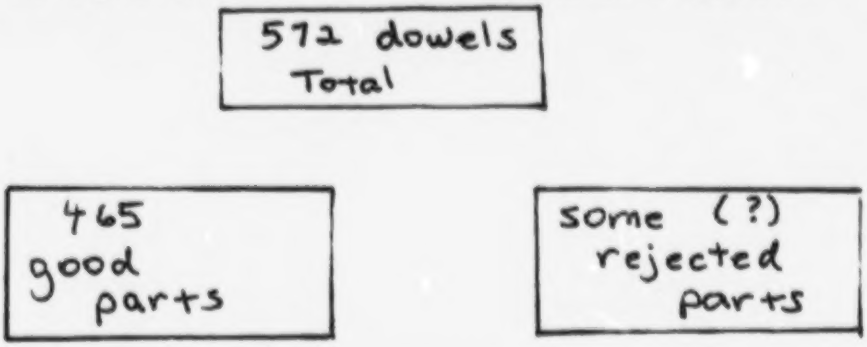
Step 5: **Is my answer reasonable?** Yes, because 6 is less than 19.

MATHEMATICS ON THE JOB I
SESSION 3

Draw Pictures or Diagrams Example

Bob bored 572 dowels on Wednesday. Of the total, 465 were good parts. How many rejected parts were there?

First, let's draw a picture of this problem to get an idea of what we're given and what we need to find. (Draw on board.)



Step 1: **The question is:** How many rejected dowels were there? In our picture this is represented by our bin with the rejected parts label and a question mark.

Step 2: **The extra information is:** No extra information is given in this problem.

Step 3: **The math operation I'll use to solve the problem is:** Subtraction. Looking at our picture, we can readily see that total dowels are 572, made up of both good parts and rejected parts. To get rejected parts, we can see that we'll need to subtract good parts from total parts.

Step 4: **The math:** 572 - 465 = 107 rejected parts. This is the ? in our picture.

Step 5: **Is my answer reasonable?** Yes, because 107 is less than 572 and rejected parts would have to be less than total parts.

Number Sentences (Example)

Sam worked 10 hours on Tuesday, 9 hours on Wednesday and 11 hours on Thursday. Last week, Sam called in sick 4 days. How many total hours did he work for the 3 days?

Using the information in this problem, we can state this in the following number sentence:

Hours worked Tuesday + Hours worked Wednesday + Hours worked Thursday = Total hours

Note that we've really just restated the problem in a kind of shorthand form. This is really only the first part of writing a number sentence. The second part involves putting in numbers before the labels where we know them.

10 hours Tuesday + 9 hours Wednesday + 11 hours Thursday = Total hours.

Step 1: **The question is:** What's the total number of hours that Sam worked over the 3 days? One way of looking at this is that it's the unknown number in our number sentence, total hours.

Step 2: **The extra information is:** He was out sick 4 days last week.

Step 3: **The math operation I'll use to solve the problem is:** Addition. Once again, from our number sentence, it's easy to see that if want total hours, we need to add. Also, a keyword in the word problem that indicates addition is total.

Step 4: **The math:** 10 + 9 + 11 = 30 hours.

Step 5: **Is my answer reasonable?** Yes, because 30 is greater than 10 and 9 and 11. Since it's the total of these 3 numbers, it would have to be greater than each one.

MATH ON THE JOB I
SESSION 3

SOLVING ADDITION AND SUBTRACTION WORD PROBLEMS PRACTICE

Homework The following seven problems can be assigned as homework, or done as classwork, depending on time constraints and the comprehension of the participants.

1. John worked 8 hours on Monday, 7 hours on Tuesday, 12 hours on Wednesday, 10 hours on Thursday, and 12 hours on Friday. How many hours did he work during this week?

   8 + 7 + 12 + 10 + 12 = 49 hours

2. An automatic machine requires servicing after every 300 hours of operation. If the operating-time indicator now reads 193 hours, how many hours remain before the next service is required?

   300 hours - 193 hours = 107 hours

3. A water pipe leaked 15 gallons the first hour, 17 gallons the second hour, and 19 gallons the third hour. How many gallons of water have been lost in three hours?

   15 gallons + 17 gallons + 19 gallons = 51 gallons of water

4. The perimeter of a triangle is found by adding together the lengths of each of its sides. If a triangle has sides measuring 14 inches, 9 inches, and 17 inches, what is the perimeter of the triangle?

14 + 9 + 17 = 40 inches

5. A container holds brushroll assemblies. The total weight of the container and brushroll assemblies is 202 kg; the container weighs 58 kg. How much do the brushroll assemblies weigh?

202 kg. - 58 kg. = 144 kg.

6. There are 61 tons of coal in a coal pile. 20 tons of coal were burned in the factory today and 18 tons of coal were burned yesterday. How many tons of coal remain in the coal pile?

61 tons - 20 tons - 18 tons = 23 tons

7. The Kirby Company ordered $38,934 worth of brushroll assemblies. Regina Dirt Devil ordered $96,725 of brushroll assemblies. How much more did Regina order than Kirby?

$96,725 - $38,934 = $57,791

Additional Problems **If you feel the class needs more practice, see the Appendix for extra addition and subtraction word problems.**

MATH ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Multiplication Definitions

Multiplicand	**The number being multiplied.**
Multiplication	**The repeated addition of identical numbers; the third basic operation in math.**
Multiplication Sign (x)	**Indicates multiplication as the operation to be performed.** **Note: These symbols can also indicate multiplication:** * • ( )( )
Multiplier	**The number of times the multiplicand is taken.**
Product	**The result (answer) of multiplying 2 or more numbers together.**
Partial Product	**The result of multiplying a number by 1 digit of another number. Partial products are added together to find the product.**

MATH ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Multiplication Table

X	1	2	3	4	5	6	7	8	9
1	1	2	3	4	5	6	7	8	9
2	2	4	6	8	10	12	14	16	18
3	3	6	9	12	15	18	21	24	27
4	4	8	12	16	20	24	28	32	36
5	5	10	15	20	25	30	35	40	45
6	6	12	18	24	30	36	42	48	54
7	7	14	21	28	35	42	49	56	63
8	8	16	24	32	40	48	56	64	72
9	9	18	27	36	45	54	63	72	81

MATH ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Class Activity

3 x 4 = 12

5 x 8 = 40

7 x 9 = 63

3 x 5 = 15

2 x 4 = 8

6 x 6 = 36

8 x 3 = 24

9 x 9 = 81

9 x 6 = 54

7 x 3 = 21

4 x 7 = 28

2 x 6 = 12

MATH ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS
The Multiplication Process

Examples **Process**

1. Arrange numbers in columns.

$$\begin{array}{r} {}^{3}25 \\ \underline{\times\ 16} \\ {}^{1}150 \\ \underline{25} \\ 400 \end{array}$$

2. Multiply the top number by the Ones place digit of the bottom number.
   a. First, multiply the Ones place digit of the top number by the Ones place digit of the bottom number. Write down the Ones place digit of the product in the Ones column. Carry the 10's place digit.
   b. Next, multiply the 10's place digit of the top number by the Ones place digit of the bottom number.
   c. Then, add the number you carried to this product. Write the number down next to the number in the Ones column.

   This is the first partial product.

$$\begin{array}{r} {}^{32}79 \\ \underline{\times\ 43} \\ 237 \\ \underline{316} \\ 3397 \end{array}$$

3. Multiply the top number by the Tens place digit of the bottom number.
   a. First, multiply the Ones place digit of the top number by the Tens place digit of the bottom number. Write down the Ones place digit of the product in the Tens column. Carry the Tens place digit.
   b. Next, multiply the Tens place digit of the top number by the Tens place digit of the bottom number.
   c. Then, add the number you carried to this product. Write the number down next to the number in the Tens column.

   This is the second partial product.

4. Add the partial products together.

IMPORTANT: Make sure the numbers are lined up correctly.

This is the final product of the two numbers.

MATH ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Multiplication Properties

Commutative Property of Multiplication	**The ordering property which states that numbers can be multiplied in any order and the product will always be the same. Similar to the commutative property of addition.**
Example:	4 x 5 = 20 5 x 4 = 20
Associative Property of Multiplication	**The grouping property which states that numbers can be grouped in any way before being multiplied and the product will always be the same. Similar to the associative property of addition.**
Example:	2 x (4 x 5) = 40 (2 x 4) x 5 = 40

MATH ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Class Activity

$$\begin{array}{r} 26 \\ \times\ 15 \\ \hline \mathbf{390} \end{array} \qquad \begin{array}{r} 87 \\ \times\ 25 \\ \hline \mathbf{2,175} \end{array} \qquad \begin{array}{r} 99 \\ \times\ 46 \\ \hline \mathbf{4,554} \end{array} \qquad \begin{array}{r} 29 \\ \times\ 73 \\ \hline \mathbf{2,117} \end{array}$$

$$\begin{array}{r} 122 \\ \times\ 18 \\ \hline \mathbf{2,196} \end{array} \qquad \begin{array}{r} 347 \\ \times\ 84 \\ \hline \mathbf{29,148} \end{array} \qquad \begin{array}{r} 875 \\ \times\ 36 \\ \hline \mathbf{31,500} \end{array}$$

Are the following mathematical statements true or false?

$3 \times 4 \times 2 = 2 \times 3 \times 4$ T

$(1 \times 9) \times 6 = 9 \times 1$ F

$48 \times (3 \times 20) = (20 \times 3) \times 48$ T

MATH ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Instructor Notes for Class Activity
Multiplication Relay Race

Divide the class up into teams of 4 people. Each team gets the same 2 activity multiplication problems. They solve the problem as a relay team. The 1st person multiplies by the 1st digit, the 2nd person multiplies by the 2nd digit, the 3rd person multiplies by the 3rd digit. The 4th person adds the partial products together. Each team completes both problems. The first team to solve both problems correctly wins! If a team sends up a problem that's wrong, send it back to be corrected.

Also, 5 people can be a team (if you don't have even teams of 4.) The 5th person can check the answers before turning the problem in.

MULTIPLICATION PROBLEMS

$$\begin{array}{r}
53{,}476 \\
\times\,135 \\
\hline
267380 \\
160428 \\
53476 \\
\hline
7{,}219{,}260 \\
\hline
\end{array}$$

$$\begin{array}{r}
762{,}914 \\
\times\,846 \\
\hline
4577484 \\
3051656 \\
6103312 \\
\hline
645{,}425{,}244 \\
\hline
\end{array}$$

MATH ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Division Definitions

Dividend	**The number to be divided.**
Division	**The repeated subtraction of one number from another; the 4th basic operation of math.**
Division Sign (+)	**Indicates division as the operation to be performed.** **Note: These symbols can also indicate division:** / ÷
Divisor	**The number of parts that the dividend is to be divided into.**
Quotient	**The number of times the divisor goes into the dividend (the answer).**
Remainder	**Any amount left over if the divisor does not go into the dividend equally.**

MATH ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Class Activity

$64 \div 8 = 8$

$24 \div 4 = 6$

$72 \div 9 = 8$

$30 \div 5 = 6$

$90 / 9 = 10$

$42 / 6 = 7$

$40 / 8 = 5$

$18 / 6 = 3$

$63 / 7 = 9$

$56 / 8 = 7$

MATH ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Long division

Examples

$$\begin{array}{r} 80 \\ 21\overline{)1692} \\ -168 \\ \hline 12 \\ -0 \\ \hline 12 \end{array}$$

$$\begin{array}{r} 183 \\ 14\overline{)2564} \\ -\underline{14} \\ 116 \\ -\underline{112} \\ 44 \\ -\underline{42} \\ 2 \end{array}$$

Process

1. Place dividend under division box. Place divisor to the left of division box.
2. Determine the number of digits in the dividend to divide the divisor into.
   a. First, try dividing the divisor into the same number of digits in the dividend.
   b. If that number of digits makes a number that's too small, add one more digit to the dividend.
3. Divide the divisor into the number of digits you determined in Step 2. Write the quotient above the last number of these digits.
4. Test your answer by multiplying the quotient by the divisor and subtracting the product from the partial dividend. If the difference is not negative and is less than the divisor, your quotient is correct. Move on to Step 5.
   a. If your difference is negative, repeat Steps 3 and 4 with a quotient that is less than your original guess.
   b. If your difference is more than your divisor, repeat Steps 3 and 4 with a quotient that is larger than your original guess.
5. Bring down the next digit in the dividend, writing it next to the difference your found in Step 4.

MATH ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Long division

6. Divide the divisor into the new dividend. Write this digit of your quotient to the right of the first digit of the quotient.

7. Test your answer by multiplying the second digit of the quotient by the divisor and subtracting the product from the new partial dividend. If the difference is not negative and is less than the divisor, the second digit of your quotient is correct. Move on to Step 8.
   a.) If your difference is negative, repeat Steps 3 and 4 with a quotient that is less than your original guess.
   b.) If your difference is more than your divisor, repeat Steps 3 and 4 with a quotient that is larger than your original guess.
8. You would continue the process of bringing down digits, dividing, and testing the quotient until the last digit in the dividend has been brought down and tested. When you've found the last digit in the quotient, you're done! Any amount left over when you subtract is called the remainder.
9. Check your answer by multiplying the divisor by the quotient and then, adding the remainder. You should come up with the dividend.

MATH ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Class Activity

4318 ÷ 7 = **616 R 6** 6781 ÷ 4 = **1,695 R 1**

$$
\begin{array}{r}
\underline{146}\ \text{R}4 \\
18\,|\,2632 \\
-\underline{18} \\
83 \\
-\underline{72} \\
112 \\
-\underline{108} \\
4
\end{array}
\qquad\qquad
\begin{array}{r}
\underline{1,228}\ \text{R}\,11 \\
36\,|\,44,219 \\
-\underline{36} \\
82 \\
-\underline{72} \\
101 \\
-\underline{72} \\
299 \\
-\underline{288} \\
11
\end{array}
$$

MATH ON THE JOB I
SESSION 3

MULTIPLYING AND DIVIDING WHOLE NUMBERS

Instructor Notes for Class Activity
Division Relay Race

Divide the class up into teams of 4 people. Each team gets the same 2 activity division problems. They solve the problem as a relay team. The 1st person finds the 1st number of the quotient and multiplies. The 2nd person subtracts and carries down the next number. The 3rd person finds the 2nd number of the quotient and multiplies. The 4th person finds the remainder. Each team completes both problems. The first team to solve both problems correctly wins! If a team sends up a problem that's wrong, send it back to be corrected.

Also, 5 people can be a team (if you don't have even teams of 4.) The 5th person can check the answers before turning the problem in.

DIVISION PROBLEMS

$$
\begin{array}{r|l}
 & \underline{21}\ \text{R}\,274 \\
751 & 16{,}045 \\
 & -\underline{1502} \\
 & 1045 \\
 & -\underline{751} \\
 & 274
\end{array}
$$

$$
\begin{array}{r|l}
 & \underline{49}\ \ \text{R}\,4{,}836 \\
5{,}328 & 265908 \\
 & -\underline{21312} \\
 & 52788 \\
 & -\underline{47952} \\
 & 4836
\end{array}
$$

APPENDIX

CHAPTER 3 - ADDITIONAL WORD PROBLEMS

Solve each of the following word problems.

1. One bid for repairing the center boring machine was $1,954. A second bid was $1,742. How much would be saved using the second bid?

   $1,954 - $1,742 = $212

2. Rudy Tafoya earns $25,000 per year. He had $1,523 withheld from his paycheck last year for income tax, but he owes only $1,379 in tax. What refund should he receive?

   $1,523 - $1,379 = $144

3. CWP now pays $439 per month for their supply of tufts. If they double their order, the payment will be $702 per month. How much extra will they pay each month?

   $702 - $439 = $263

4. A forklift truck now goes 374 miles on a tank of gas. After a tune-up, the same forklift will go 401 miles on a tank of gas. How many additional miles will it go after the tune-up?

   401 Miles - 374 Miles = 27 Miles

5. At People's Bank, Cleveland Wood Products can earn $14,608 per year in interest, while Farmer's Bank would pay $15,543 interest. How much additional interest would CWP earn at the second bank in one year?

   $15,543 - $14,608 = $935

APPENDIX

CHAPTER 3 - ADDITIONAL WORD PROBLEMS

A salesmen and his manager need to travel from Washington to Denver to visit a major client. Approximate one-way travel costs for two adults are listed below. Find the total cost for each form of transportation.

WASHINGTON TO DENVER

Airplane (4 hours one way)

Coach Fare	$944
Meals	No Charge

Bus (44 hours one way)

Fare	$614
Meals	68

Train (42 hours one way)

Coach Fare	$492
Meals	98

Automobile (72 hours one way)

Gasoline and Maintenance	$905
Tolls	6
Meals	174
Lodging	136

A. How much money could the company save if the men travelled round trip by bus rather than by automobile?

Bus fare: $614 + $68 = $682 one way for 2 people; $1,364 round trip
Car cost: $905 + $6 + $174 + $136 = $1,221 for 2 people; $2,442 round trip

Savings: $2,442 in car - $1,364 in bus = $1,078

2. How much time could the salesmen save if they travelled round trip by bus rather than by automobile?

Bus time: 44 hours one way; 88 hours round trip
Car time: 72 hours one way; 144 hours round trip

Time saved: 144 hours in car - 88 hours in bus = 56 hours

3. How much money could the company save if the men travelled round-trip by train rather than plane?

Train fare: $492 + $98 = $590 one way; $1,180 round trip
Plane fare: $944 one way; $1,888 round trip

Amount saved: $1,888 - $1,180 = $708

4. How much longer would a round-trip take by car compared to a plane?

Car time: 72 hours one way; 144 hours round trip
Plane time: 4 hours one way; 8 hours round trip

Additional time required: 144 hours - 8 hours = 136 hours

CLEVELAND WOOD PRODUCTS

MATHEMATICS ON THE JOB I

OBJECTIVES

SESSION 4

- Introduction to calculators.
- Demonstrate the ability to solve word problems involving multiplication and division of whole numbers on job-related materials.

MATHEMATICS ON THE JOB I
SESSION 4

INTRODUCTION TO CALCULATORS

Introduction

Calculators are among the most popular inventions of recent years. Calculators constantly become more powerful, and cheaper; today's calculators perform calculations that could previously be done only by mainframe computers. There are many models of calculators, made by a wide variety of companies, but most operate in a very similar manner.

The problem 9 + 8 would be entered as

9 + 8 =

and 17 would appear as the answer. Enter 17 - 8 as

1 7 - 8 =

and 9 appears as the answer.

When entering large numbers, do not try to enter a comma. However, **if the number has a decimal point** (as in dollars and cents), **be sure to press the period key at the appropriate place in the number**. Sometimes, when doing a problem with dollars and/or decimals, the calculator will show just one number after the decimal point, for example:

97.5

If there is just one number after the decimal point and you need dollars and cents, just add a zero at the end of the answer. The answer above would represent $97.50.

Introduction (cont.)

All calculators have a **C** key. **This key erases everything in the calculator and prepares the calculator to begin a new problem.**

Some calculators also have a **CE** key. **Pressing this key erases only the number showing on the display screen** and allows the person using the calculator to correct a mistake without having to start the problem over.

Some calculators have a combination **C/CE** key. In this case, **pressing the key once will erase the entry just made,** and **pressing it twice will clear out the calculator and get it ready for the next problem.**

For the rest of this course, there will be some problems for you to work without calculators, and some (harder) problems for you to try with a calculator.

Try entering these problems into your calculator, and see if you get the right answer. **If you get confused, press the C/CE key twice and try again.**

Classwork

The following section, Calculator Practice, is to be done as classwork so that the instructor can verify that all participants understand the functioning of the calculator.

MATHEMATICS ON THE JOB I
SESSION 4

CALCULATOR PRACTICE

511 23 154 + 10 **698**	324 7,855 23 + 86 **8,288**	$ 3.58 249.63 7.03 + .09 **$ 260.33**	$ 3,299.99 141.00 25.36 + .95 **$ 3,467.30**

Did you remember to add a zero at the end of the last answer? The problem is with dollars and cents, so the .3 actually meant 30 cents.

Now try these:

9,431 - 210 **9,221**	7,000 - 4,999 **2,001**	587 - 342 **245**	9,742 - 8,131 **1,611**
$ 4,271.35 372.54 8,976.76 + 162.05 **$ 13,782.70**	57 4 392 + 162 **615**	3,214 762 936 + 8,325 **13,237**	11,746 21,892 + 43,925 **77,563**
6,259 - 4,148 **2,111**	46,253 - 5,123 **41,130**	9,988 - 677 **9,311**	75,904 - 3,702 **72,202**

MATHEMATICS ON THE JOB I
SESSION 4

SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

A Review of the 5-Step Process

Step 1. **What is the question?** ________________________________

____

____

Step 2. **What is the extra information?**

____

____

Step 3. **What mathematical operation(s) will I use to arrive at the answer?**

____

____

Step 4. **Do the math. (Be sure to check your work.)**

____

____

Step 5. **Ask yourself "Is my answer reasonable?"**

____

MATHEMATICS ON THE JOB I
SESSION 4

SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

Multiplication Word Problems
Example

Nancy painted 413 dowels every day for 5 days. How many dowels did she paint this week?

Step 1: **How many dowels did Nancy paint this week?**

Step 2: **None**

Step 3: **Multiplication**

Step 4: **413 x 5 = 2,065 dowels**

Step 5: **Yes.**

MATHEMATICS ON THE JOB I
SESSION 4

SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

Multiplication Key Words

Multiplied
Times
Total
Of
Per
As much
Twice
By
Area
Volume

Facilitator 4-6

MATHEMATICS ON THE JOB I
SESSION 4

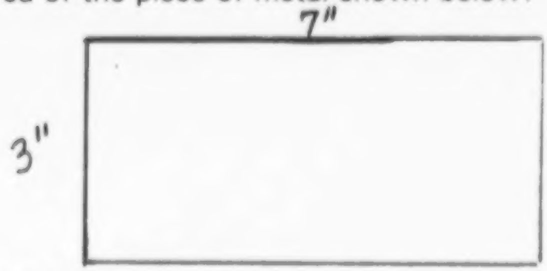
SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

Areas

To find the area of a square or rectangle, you **multiply the length times the width.** Area is expressed in square units.

Examples: square inches, square feet

What is the area of the piece of metal shown below?



Step 1: Find the area of the metal.

Step 2: None

Step 3: Multiplication; keyword: Area

Step 4: 3 x 7 = 21 square inches (It is important to state the answer in square inches.)

Step 5: Yes.

MATHEMATICS ON THE JOB I
SESSION 4

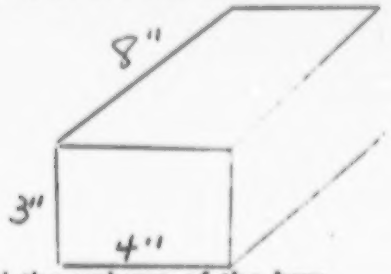
SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

Volumes

To find the volume of a rectangle, you **multiply the length times the width times the height**. Volume is expressed in cubic units.

Examples: cubic inches, cubic feet

What is the volume of the box shown below?



Step 1: Find the volume of the box.

Step 2: None

Step 3: Multiplication; keyword: Volume

Step 4: 3 x 4 x 8 = 96 cubic inches (It's important that the answer is expressed in cubic inches.)

Step 5: Yes.

MATHEMATICS ON THE JOB I
SESSION 4

SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

Division Word Problems
Example

Gary has to pack 575 dowels in boxes that hold 25 dowels each. There are 2 skids of boxes near his work area. How many boxes will he need?

Step 1: How many boxes will Gary need to pack dowels into?

Step 2: There are 2 skids of boxes near his work area.

Step 3: Division

Step 4: 575 ÷ 25 = 23 boxes

Step 5: Yes.

MATHEMATICS ON THE JOB I
SESSION 4

SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

Division Key Words

Divided

Split

Each

Cut

Equal pieces

Average

Every

Out of

Ratio

Shared

MATHEMATICS ON THE JOB I
SESSION 4

SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

Averages

Sam bored 9,840 dowels for the month of October. He worked 20 days during the month and left early 3 times. What was his average daily production?

Step 1: What was Sam's average daily production for October?

Step 2: He left early 3 times.

Step 3: Division; keyword: Average

Step 4: 9,840 ÷ 20 = 492 dowels per day

Step 5: Yes.

MATHEMATICS ON THE JOB I
SESSION 4

The Total-Part Method

5 machines each produce 74 dirt magnets per hour. How many dirt magnets can all 5 machines produce in 6 hours?

TOTAL = ?

5 MACHINES
(PART)

74 DIRT MAGNETS
PER HOUR
(PART)

6 HOURS
(PART)

Step 1: How many dirt magnets can 5 machines produce in 6 hours? (Total)

Step 2: None

Step 3: Multiplication since we're trying to find the total.

Step 4: 5 x 74 x 6 = 2,220 dirt magnets

Step 5: Yes.

MATHEMATICS ON THE JOB I
SESSION 4

SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

The Total-Part Method

5 machines each bore 74 dowels per hour. How many hours would all 5 machines need to run to bore 3,330 dowels?

3,300 DOWELS
TOTAL

5 MACHINES
(PART)

74 DOWELS
PER HOUR
(PART)

? HOURS
(PART)

Step 1: How many hours would be needed for 5 machines to bore 3,330 dowels? (Part)

Step 2: None

Step 3: Multiplication to multiply the 2 parts we have together; then division to find the part we're looking for.

Step 4: 5 x 74 = 370 dowels per hour; 3,330 ÷ 370 = 9 hours.

Step 5: Yes.

SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS

Word Problems Involving More Than One Operation

Sheila's machine makes 3 brushroll assemblies per minute. Inspection can inspect 100 assemblies per hour. The paint department can paint 50 dowels each hour. How many assemblies will be waiting for inspection at the end of 2 hours, assuming Sheila continues working at the same pace?

Step 1: At the end of 2 hours, how many assemblies will be waiting for inspection?

Step 2: The paint department paints 50 dowels per hour.

Step 3: Multiplication to get assemblies produced per hour; then subtraction to find how many assemblies are left waiting at the end of one hour; then multiplication again to find how many assemblies are left waiting at the end of 2 hours.

Step 4: 3 x 60 = 180 assemblies produced per hour; 180 - 100 = 80 dowels waiting at the end of 1 hour; 2 x 80 = 160 assemblies waiting at the end of 2 hours. Please note there are other approaches to this problem.

Step 5: Yes.

MATHEMATICS ON THE JOB I
SESSION 4

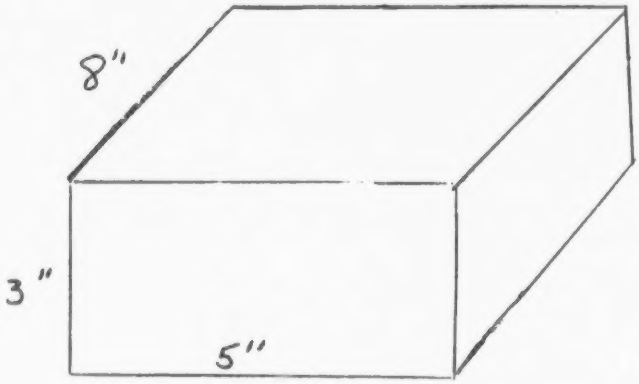
SOLVING MULTIPLICATION AND DIVISION WORD PROBLEMS
PRACTICE

Homework

1. 5 packers ship 20,000 side kick brush assemblies per day. If each packer loads 25 shipping cartons per day, how many brush assemblies are in a shipping carton?

   160 brushes per shipping carton

2. What is the volume of the piece of metal shown below?



Volume = 120 cubic inches

3" x 5" x 8" = 120 cubic inches

3. The Kirby cell measures 2 pieces every 2 hours. They get 2 15-minute breaks each shift. How many pieces do they measure each 8-hour shift?

In an 8-hour shift, there are 4 two-hour segments (8 / 2 = 4 segments)

2 pieces x 4 segments = 8 pieces

4. A single automated paint shift produces 4,000 dowels per shift. If each shift runs 8 hours, how many shifts will it take to paint an order of 24,000 dowels?

24,000 total dowels / 4,000 dowels per shift = 6 shifts

5. The number of reworked Regina dirt magnets during a week is listed below. Give the range of reworked magnets, and then find the average number of parts needing rework each day.

Monday: 4	Wednesday: 35	Friday: 15
Tuesday: 6	Thursday: 0	

Range is from 0 to 35 magnets. Remind class that the average must fall within the range.

4 magnets + 6 magnets + 35 magnets + 0 magnets + 15 magnets = 60 magnets

60 magnets / 5 days = 12 magnets.

Additional problems can be found in the Appendix, and can be used at your discretion.

MATHEMATICS ON THE JOB I
SESSION 4

CHAPTER 4 – ADDITIONAL WORD PROBLEMS

1. Maria works overtime each week; she is paid time and a half for any hours over 40 each week. Her hourly wage is $14.80. In November last year, Maria worked 40 hours the first week, 55 hours the second week, 45 hours the third week, and 41 hours the last week. How much did Maria earn in November ? (before taxes or other deductions were taken out of her check)

Hourly wage: $14.80; Overtime wage: (1/2 x $14.80) + $14.80 = $22.20

Week	**Regular Hours**	**Overtime Hours**
First	**40**	**0**
Second	**40**	**15**
Third	**40**	**5**
Fourth	**+40**	**+ 1**
	160	**21**
	x $14.80	**x $22.20**

Regular wage = $2,368 **$ 466.20 = Overtime wage**

Total wages for month = $2,368 + $466.20 = $2,834.20

MATHEMATICS ON THE JOB I
SESSION 4

CHAPTER 4 - ADDITIONAL WORD PROBLEMS

2. Joe Stefanopoulos earns $13.64 an hour, and time and a half for any hours over 40 per week. Below is his time sheet for March. How much did he earn in overtime pay?

First week, March	53 hours
Second week, March	52 hours
Third week, March	40 hours
Fourth week, March	62 hours

Hourly wage: $13.64; Overtime wage: (1/2 x $13.64) + $13.64 = $20.46

Week	**Overtime Hours**
First	**13**
Second	**12**
Third	**0**
Fourth	**+22**
	47
	x $20.46

$ 961.62 = Overtime wage

3. You accrue sick time at the rate of 1 day every 3 months. At the end of 2 years, assuming you have never called in sick, how much sick time have you accrued? You have just gotten a raise and earn $16.25 per hour.

In one year, there are 4 units of 3 months each (12 / 3)
In two years, there would be 8 units

You get 1 day/unit, therefore, you would have 8 days.

Remind the class that the amount of your raise is immaterial to this problem.

CHAPTER 4 - ADDITIONAL WORD PROBLEMS

4. Anita Harris earns 1 day of sick leave for every month she works after her initial 3-month probation. She also earns 1 day of vacation per month, beginning from her first day of employment. At the end of a year and a half, assuming she has not called in sick, how much sick time has she accrued?

Note: the amount of vacation accrued is immaterial for this problem.

In the first year, Anita has accrued 9 days. (12 months - 3 month probation period)

The next half year, she accrues 6 days. (12 months x 1/2)

The total after a year and a half = 15 days (9 days + 6 days)

5. Julio Gomez likes to work overtime because he earns time and a half for every hour over 44 hours per week. His regular rate of pay is $9.50 per hour. The first week of last month he worked 44 hours, the second week 45 hours, the third week 50 hours, the fourth week 48 hours. So far this month, he worked 55 hours the first week and 60 hours the second week. How much did Julio earn last month (before taxes or other deductions were taken out of his check)?

Hourly wage: $9.50; Overtime wage: (1/2 x $9.50) + $9.50 = $14.25

Week	**Regular hours**	**Overtime Hours**
First	**44**	**0**
Second	**44**	**1**
Third	**44**	**6**
Fourth	**+ 44**	**+ 4**
	176	**11**
	x $9.50	**x $14.25**

Regular wage = $ 1,672 **$ 156.75 = Overtime wage**

Total wages for month = $1,672 + $156.75 = $1,828.75

MATHEMATICS ON THE JOB I
SESSION 4

CHAPTER 4 - ADDITIONAL WORD PROBLEMS

6. The paint machine must be serviced after every 200 hours of operation. If the machine can paint 375 dowels per hour, how many dowels will be painted between each service call?

   375 dowels x 200 hours = 75,000 dowels

7. Because the service calls for routine maintenance on the center boring machines are getting very expensive, CWP has requested bids from different companies to do the work. Three bids were obtained. The current servicer (Acme Company) charges $500 for a three-month contract, plus a $75 charge per call. (There are normally 2 calls per month.) Beta Company charges a flat $1,000 for a three-month contract, and all service calls are included. Capstone Company charges only on a per-call basis, at the rate of $375 per call. Capstone is a sister company to CWP. Which company would be the cheapest for the three months?

   Acme: **$500 + (6 calls x $75) = $950**

   Beta: **$1,000 includes all service calls**

   Capstone: **6 calls x $375 = $2,250**

   Acme would be the cheapest, if there are really only 2 calls per month.

   Note: The fact that Capstone is a sister company is not relevant to the math of the problem, although it may influence the final choice of a service company.

8. CWP works 8-hour shifts, and closes for the week between Christmas and New Year's. Generally, there are some workers on layoff who could be called in to cover for absent employees. On Tuesday, 4 workers called in sick, and no replacements could be found. How many man-hours were lost?

   Note: the fact that the plant closes for one week between Christmas and New Year's is not relevant for this problem.

   4 workers x 8-hour shift = 32 man-hours lost

CHAPTER 4 - ADDITIONAL WORD PROBLEMS

9. The boring machine appeared to be misfeeding quite a bit this week. The serviceman was called out 3 times, and said the machine was fine. However, there were lots of rejects due to this machine: 40 dowels Monday, 35 Tuesday, 27 Wednesday, 15 Thursday, and 47 Friday. If this continues for 3 weeks, how many rejected dowels will there be?

40 dowels + 35 dowels + 27 dowels + 15 dowels + 47 dowels = 164 dowels for 1 week

164 dowels x 3 weeks = 492 dowels rejected

Note: the fact that the serviceman was called out 3 times this week is not relevant for this problem.

10. The Kirby cell is packing boxes for an order which needs to be shipped today. If each box can hold 14 brushroll assemblies along the short side, and 25 along the longer side, how many brushroll assemblies can be packed in each box?

Note: the fact that the order needs to be shipped today is not relevant to the problem.

14 assemblies x 25 assemblies = 350 assemblies

11. The Regina Company ordered 3,825 dirt magnets. They were shipped 137 boxes of 3 dozen magnets each. Did Regina receive the right number of dirt magnets? If not, were they over or short, and by how much?

The company received:

137 boxes x 3 dozen = 137 boxes x 36 magnets each = 4,932 magnets

They ordered 3,825 magnets, so:

4,932 received - 3,825 ordered = 1,107 too many received

MATHEMATICS ON THE JOB I
SESSION 4

CHAPTER 4 - ADDITIONAL WORD PROBLEMS

12. Philip DiSantis is being trained on the use of the center boring machine, and is having trouble seating the dowels properly. The number of rejects for his first week is as follows: Monday: 25; Tuesday: 38; Wednesday: 41; Thursday, 43; Friday: 49. What is the range of rejects? What is the average? What is the total?

The range is 25 - 49.

The total is 25 + 38 + 41 + 43 + 49 = 196 rejects

The average is 196 rejects / 5 days = 39.2 rejects average per day

(39 or 40 would be acceptable, since we have not yet discussed rounding.)

CLEVELAND WOOD PRODUCTS

MATHEMATICS ON THE JOB I

OBJECTIVES

SESSION 5

- Introduction to fractions.
- Demonstrate the ability to convert fractions to decimals.
- Demonstrate the ability to correctly read rulers and gages.

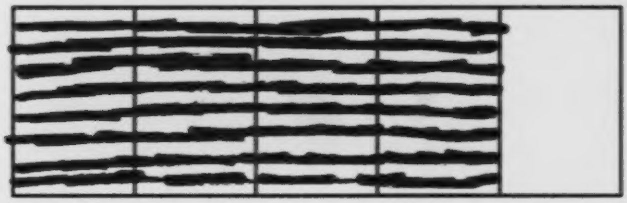
MATHEMATICS ON THE JOB I
SESSION 5

Fractions and Decimals

What is a fraction?

Introduction

A fraction is a number whose value is between 0 and 1. A fraction tells you that a whole number has been divided into 2 or more equal parts and that you have a certain number of those parts. For instance, consider the rectangle below:



How many parts is it divided into? 5

How many parts are shaded? 4

Write a fraction to represent the shaded portion of the rectangle. 4/5

Fractions Definitions

Denominator — The lower numeral of a fraction, the numeral indicating how many parts the whole has been divided into.

Numerator — The upper numeral of a fraction, the numeral indicating how many parts of the whole you have.

Comparing Fractions

Which fraction is larger?

3/16 7/16

Why? If the denominators of 2 fractions are the same, the one with the largest numerator is larger.

Which fraction is larger?

1/3 1/6

Why? If the numerators of 2 fractions are the same, the one with the smaller denominator is larger.

Practice

Allow the class to practice deciding which of the pair of fractions is larger. If there is confusion, give the following rule so it can initially be done by rote. Additional practice on choosing the larger fraction is given in the appendix. Use them at your discretion. Remember that in this class, most of the work is done on decimals; fractions are only introduced as a way to begin to understand decimals as parts of whole numbers. It is not necessary for the class to understand fractions perfectly: that could potentially take half the course.

Choosing the larger fraction:

1. When the bottom numbers are the same, choose the fraction with the larger number on top.
2. When the top numbers are the same, choose the fraction with the smaller number on the bottom.

MATHEMATICS ON THE JOB I
SESSION 5

Practice **Which fraction is bigger?**

$\frac{2}{7}$ [✓ $\frac{2}{5}$] $\frac{15}{30}$ [✓ $\frac{15}{26}$]

[✓ $\frac{10}{12}$] $\frac{6}{12}$ $\frac{3}{5}$ [✓ $\frac{4}{5}$]

$\frac{1}{10}$ [✓ $\frac{1}{9}$]   [✓ $\frac{97}{100}$] $\frac{95}{100}$

$\frac{42}{70}$ [✓ $\frac{45}{70}$]   [✓ $\frac{7}{9}$] $\frac{4}{9}$

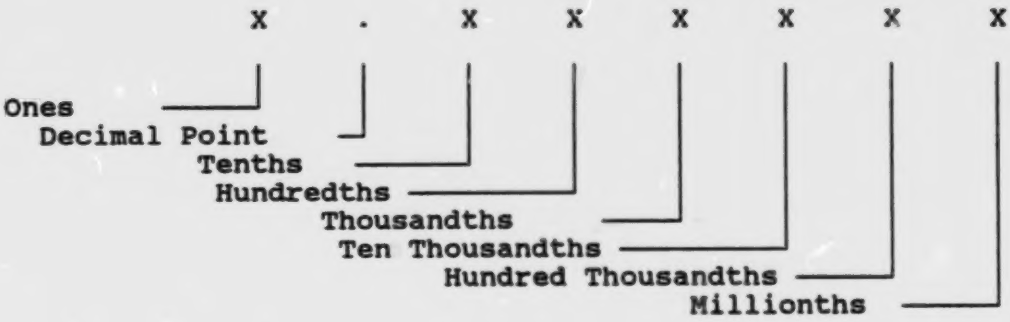
$\frac{3}{4}$ [✓ $\frac{6}{4}$] $\frac{13}{26}$ [✓ $\frac{15}{26}$]

MATHEMATICS ON THE JOB I
SESSION 5

Fractions, Decimals and Percents

Introduction

A decimal is a fraction that has a denominator that is a multiple of 10. However, in writing decimals, the denominator is indicated by place value. The place values of numerals to the left of the decimal point are shown below:


X . X X X X X X
Ones
Decimal Point
Tenths
Hundredths
Thousandths
Ten Thousandths
Hundred Thousandths
Millionths

What are the values of the following decimals?

.4	4/10
.04	4/100
.004	4/1000
.0004	4/10,000
.00004	4/100,000
.000004	4/1,000,000

If necessary, point out to participants that the decimal point "represents" the 1, and you add a zero to the denominator for each decimal place after the decimal point. For example, the denominator of .04 = 100; the 1 is "represented" by the decimal point, and because there are 2 numbers after the decimal (0 and 4), you add 2 zeroes to the denominator, hence 100.

MATHEMATICS ON THE JOB I
SESSION 5

Decimal Definitions

Decimal Point (.)	The point or dot in a decimal indicating the separation between the whole and fractional parts of the number.
Decimal Place	The number of digits to the right of the decimal point.

How many decimal places are in each of the following numbers?

32.46	2
5.7638	4
191.1	1
20.00	2

Rounding Numbers To round a number to 3 decimal places, for example, draw a vertical line between the 3rd and 4th numbers, like this

6. 3 2 8¦6 1 0

Is the number immediately after (to the right of) the line 5 or bigger? If so, the 8 becomes 9 and the rounded number is 6.329.

If the number immediately after (to the right of) the line is less than 5, then all the numbers to the right of the line just go away.

Rounding Numbers (Cont.)

Round 6.328310 to 3 decimal places:

6. 3 2 8|3 1 0

Because the number after the vertical line is 3, all the numbers after the line just go away.

Practice

Round these numbers to 2 decimal places:

Number	Answer
A. 1 4. 3 2|7 6 5	14.33
B. 7. 1 2|3	7.12
C. 3 2 5.7 0|0	325.70
D. 4 8. 9 3|5 2 7 6	48.94
E. 1 0. 9 9|9 9 9 9 9 9 9	11.00
F. 1, 2 3 7. 4 7|1 0 2 9	1,237.47
G. 3 5, 4 1 1. 3 3|3 7 6	35,411.33
H. 1 0, 1 9 8. 9 5|3 1 4	10,198.95
I. 2 5, 3 7 7. 9 1|0 8 3 1 2 7	25,377.91
J. 1. 0 0|3 1 4	1.00

MATHEMATICS ON THE JOB I
SESSION 5

Converting Fractions to Decimals

Conversions To convert a fraction to a decimal, simply divide the denominator into the numerator and carry out the division to the desired number of decimal places.

Examples: To change 3/4 to a decimal, divide 4 into 3.

$$\begin{array}{r} .75 \\ 4\,|\overline{3.00} \\ -\,2\,8 \\ \hline 20 \\ -\,20 \\ \hline 0 \end{array}$$

Change 25/32 to a decimal. Round to 3 decimal places.

$$\begin{array}{r} .781 \\ 32\,|\overline{25.000} \\ -\,22\,4 \\ \hline 2\,60 \\ -\,2\,56 \\ \hline 40 \\ -\,32 \\ \hline 8 \end{array}$$

MATHEMATICS ON THE JOB I
SESSION 5

Practice Allow participants to use their calculators to convert these fractions to decimals. Round all to 3 decimal places:

Fraction	Decimal Equivalent	Fraction	Decimal Equivalent
A. $\frac{4}{5}$	**.800**	J. $\frac{7}{8}$	**.875**
B. $\frac{97}{129}$	**.7519 = .752**	K. $\frac{5}{6}$	**.8333 = .833**
C. $\frac{36}{74}$	**.4864 = .486**	L. $\frac{24}{97}$	**.2474 = .247**
D. $\frac{76}{140}$	**.5428 = .543**	M. $\frac{17}{39}$	**.4358 = .436**
E. $\frac{1}{4}$	**.250**	N. $\frac{41}{109}$	**.3761 = .376**
F. $\frac{2}{3}$	**.6666 = .667**	O. $\frac{2}{4}$	**.500**
G. $\frac{1}{3}$	**.3333 = .333**	P. $\frac{3}{8}$	**.375**
H. $\frac{111}{297}$	**.3737 = .374**	Q. $\frac{4}{9}$	**.4444 = .444**
I. $\frac{47}{86}$	**.5465 = .547**	R. $\frac{5}{12}$	**.4166 = .417**

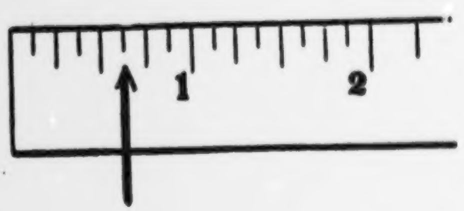
MATHEMATICS ON THE JOB I
SESSION 5

Reading Rulers and Gages

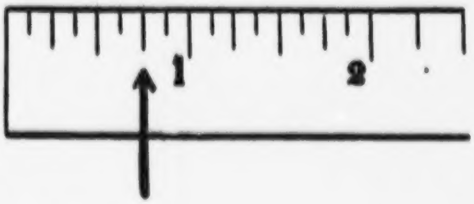
Rulers and gages

Rulers and gages divide large units of whole numbers into their fractional parts. Look at the ruler below. There are eight sections between the end of the ruler and the one inch line. Each of these sections is 1/8 of an inch. Notice that there are some longer lines and some shorter lines. How many spaces are between the longer lines? Did you count 4? Yes; that means that each section between the longer lines is 1/4th of an inch.

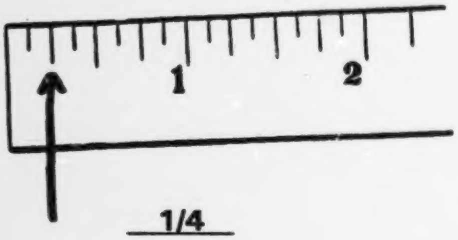
What is the measurement shown on each ruler below?



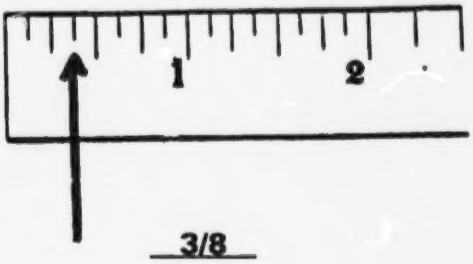
5/8



3/4



1/4



3/8

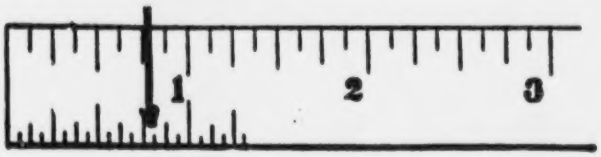
MATHEMATICS ON THE JOB I
SESSION 5

Rulers and Gages (cont.)

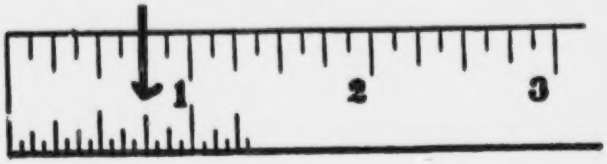
Most rulers and gages, however, have even more subdivisions than fourths and eighths. You can use the same process to read them: count how many spaces are between lines of the same length.

Mark each of the rulers below with an arrow at the indicated measurement.

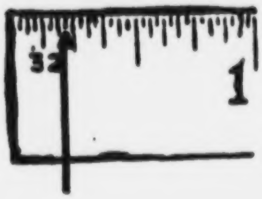
13/16



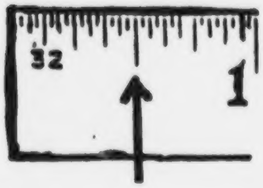
12/16



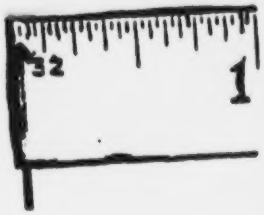
7/32



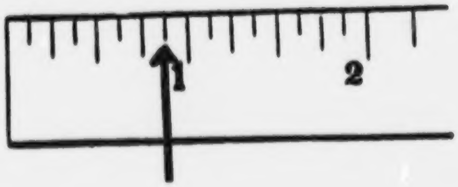
16/32



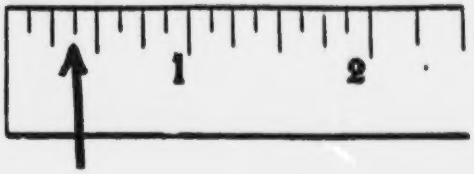
1/32



7/8



3/8



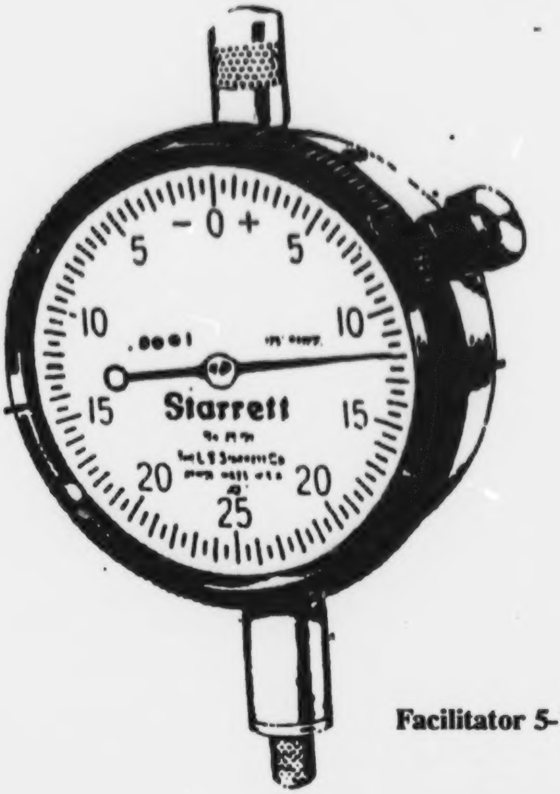
MATHEMATICS ON THE JOB I
SESSION 5

Reading Gages

There are many different types of gages in use, but all share some common characteristics:

- Generally, only **some** intervals are labeled. For example, in the gage shown below, only 5, 10, 15, etc. are labeled. In order to figure out the markings in between the numbers, start with the longer lines. Try counting longer lines and see if you reach the number shown next, without any longer lines left over. For example, there are 10 spaces between 0 and 5 on the gage below, so it is easy to see that the short line is 1/2, and the longer line is the whole number. In other words, to count the spaces on this gage, you need to count: 1/2, 1, 1 1/2, 2, 2 1/2, 3, 3 1/2, etc. That method of counting will take you to 5 with no lines left over.

- **This gage has both positive and negative markings.** The numbers are the same, but those on the left hand of the dial are negative numbers (see the negative sign to the left of 0). Those on the right side of the dial are positive numbers. (The + is on the right of the 0.)



- Gages generally have a "code" on the face which tells how to read the numbers. For example, on the gage shown here, **the "code" is .0001**. That means, you must put a decimal point at the beginning, and the number the needle points to at the end, and fill in the middle with zeroes. The number is read out loud as a fraction, for example: 1/10,000ths.

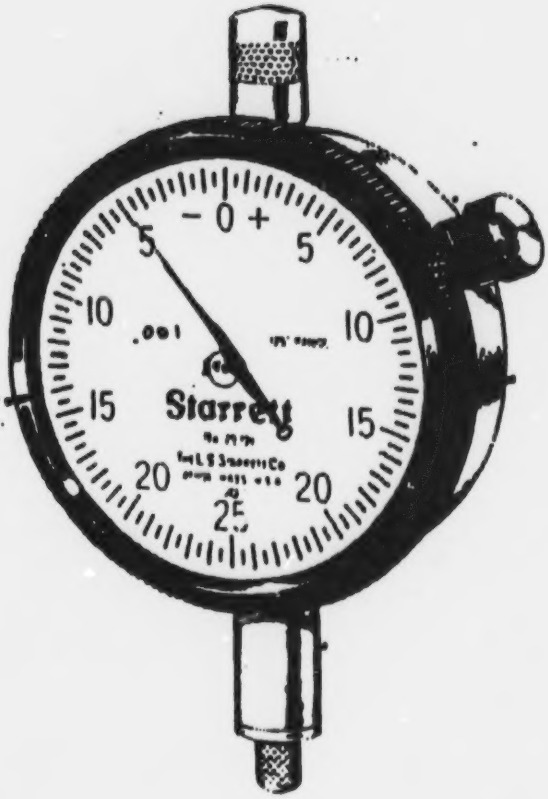
The gage shown is indicating a reading of 12. It is written ".0012", and is verbally read as 12/10,000ths.

MATHEMATICS ON THE JOB I
SESSION 5

Reading Gages (Cont.)

Be careful as you do the practice exercises here: each gage can have a different "code" for how to read the numbers.

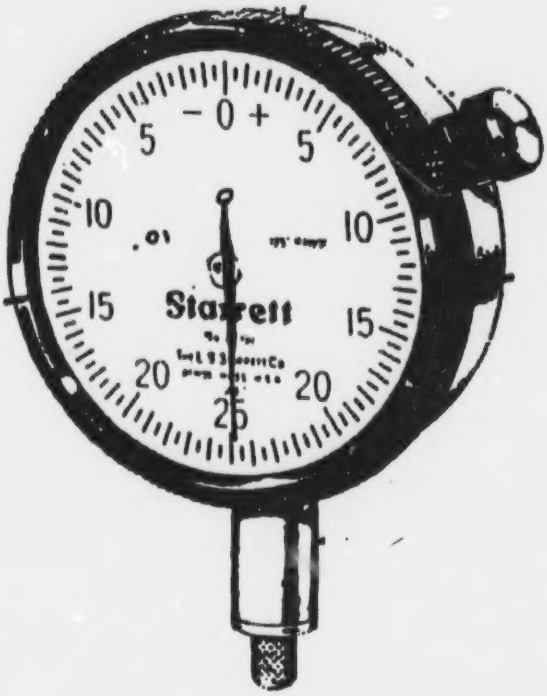
For the gages shown below, write the number the needle is pointing to, and then write how the number would be read, using both the decimal and fraction forms. See the example:



- 0 +
5
5
10
10
.001
Starrett
15
15
20
20
25

-5

-.005 -5/1,000ths

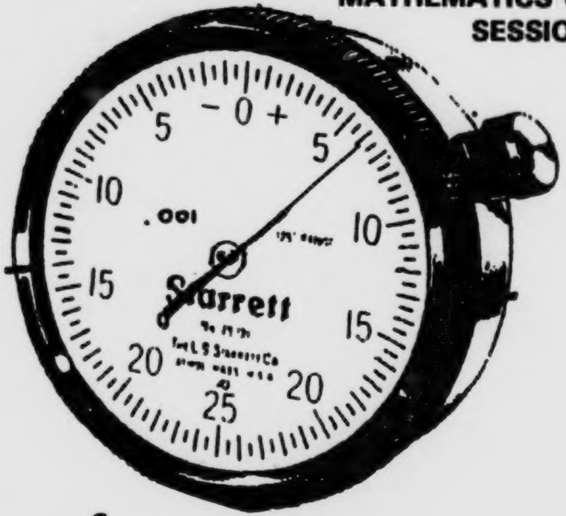


- 0 +
5
5
10
10
.01
Starrett
15
15
20
20
25

25

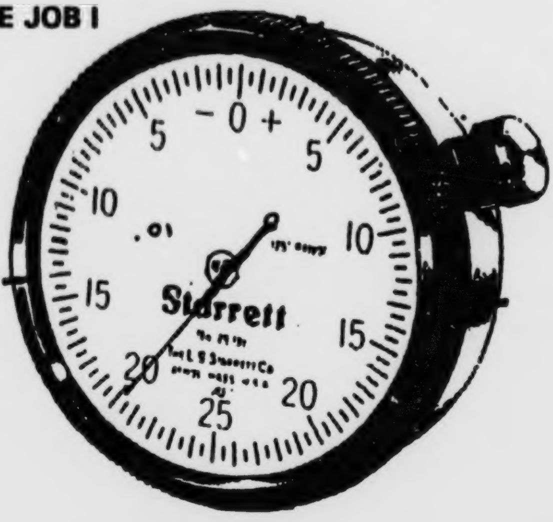
.25 25/100ths

MATHEMATICS ON THE JOB I
SESSION 5


- 0 +
.001
Starrett

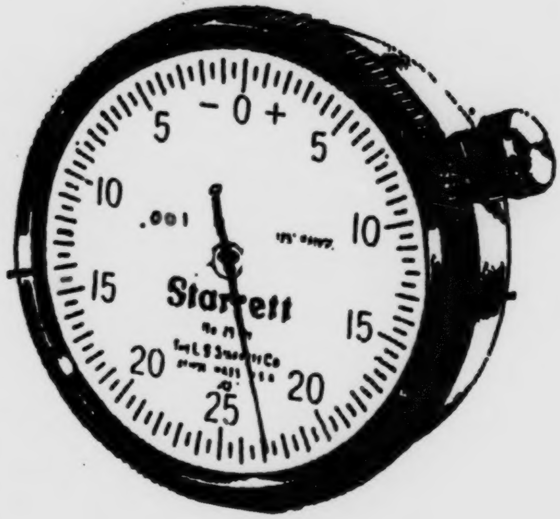
6

.006 6/1,000ths


- 0 +
.01
Starrett

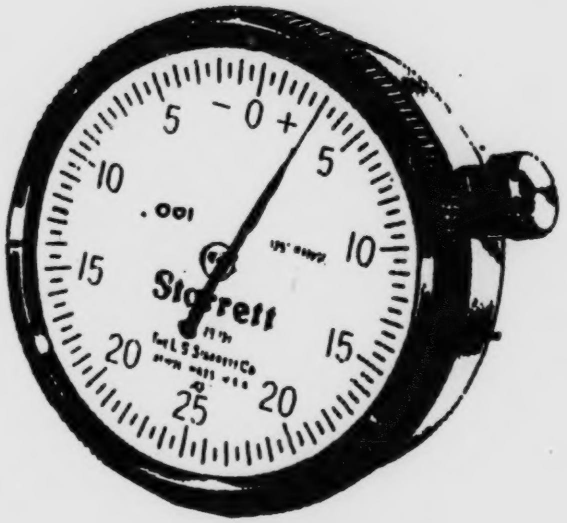
- 20

- .20 -20/100ths


- 0 +
.001
Starrett

23

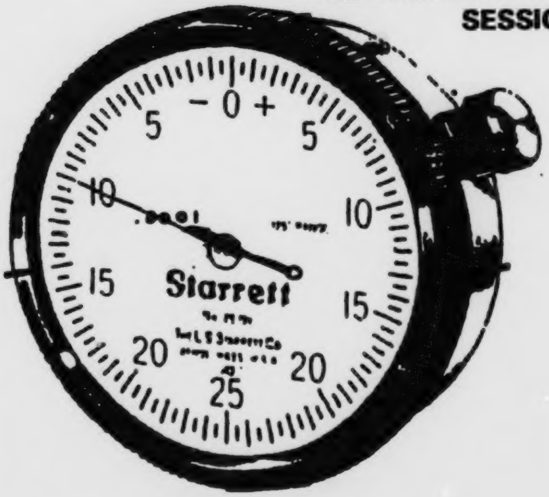
.023 23/1,000ths


- 0 +
.001
Starrett

3

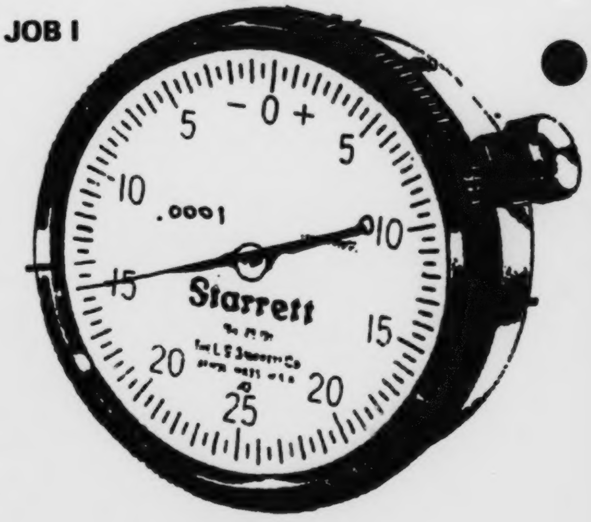
.003 3/1,000ths

MATHEMATICS ON THE JOB I
SESSION 5


- 0 +
5
5
10
10
15
15
20
20
25
.0001
Starrett

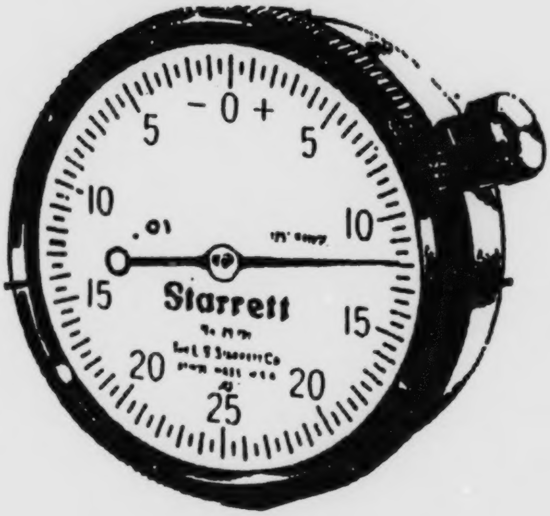
- 10

- .0010 - 10/10,000ths


- 0 +
5
5
10
10
15
15
20
20
25
.0001
Starrett

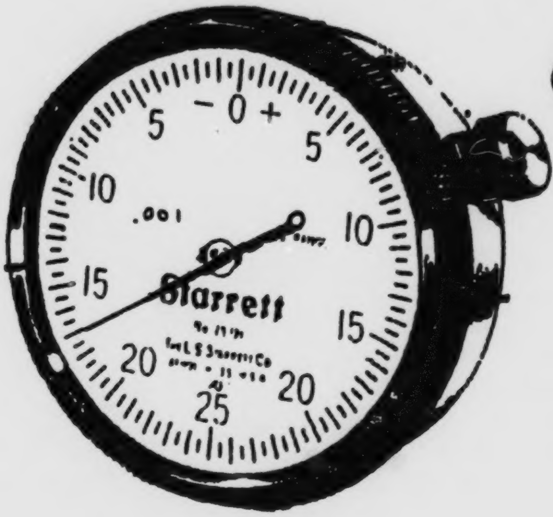
- 15

- .0015 -15/10,000ths


- 0 +
5
5
10
10
15
15
20
20
25
.01
Starrett

12

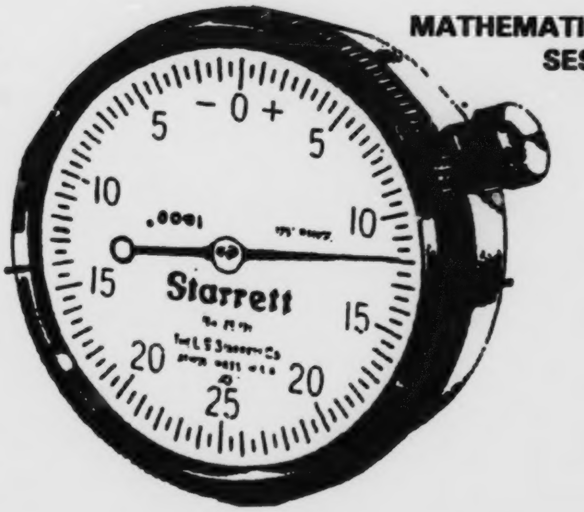
.12 12/100ths


- 0 +
5
5
10
10
15
15
20
20
25
.001
Starrett

- 17

- .017 -17/1,000ths

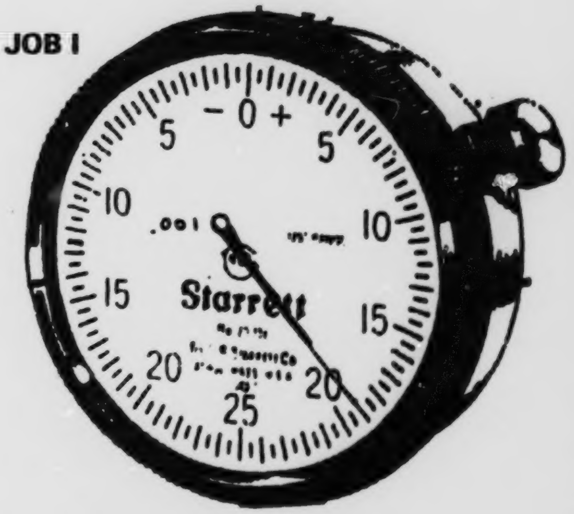
MATHEMATICS ON THE JOB I
SESSION 5



- 0 +
5
5
10
10
15
15
20
20
25
.0001
Starrett

12

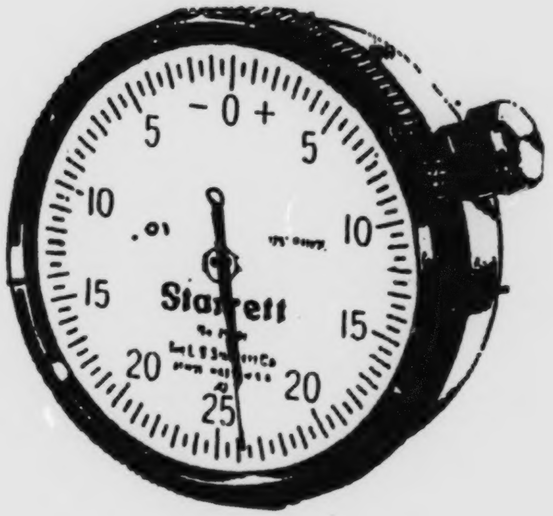
.0012 12/10,000ths



- 0 +
5
5
10
10
15
15
20
20
25
.001
Starrett

19

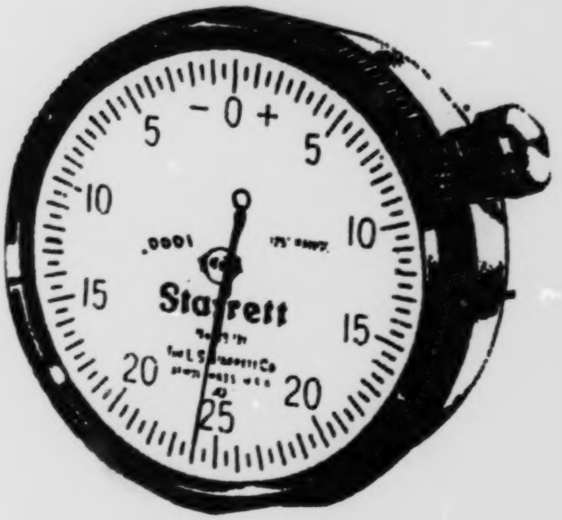
.019 19/1,000ths



- 0 +
5
5
10
10
15
15
20
20
25
.01
Starrett

24

.24 24/100ths



- 0 +
5
5
10
10
15
15
20
20
25
.0001
Starrett

- 24

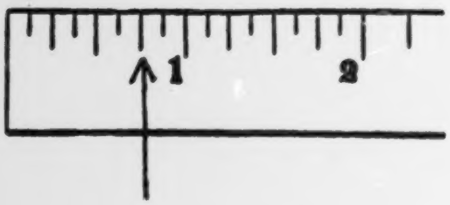
- .0024 - 24/10,000ths

MATHEMATICS ON THE JOB I
SESSION 5

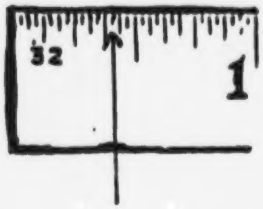
APPENDIX

Write the measurements shown by the arrows on the following rulers, in fractions:

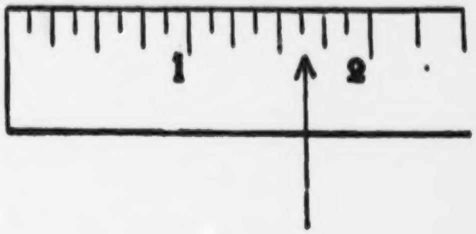
6/8, 3/4



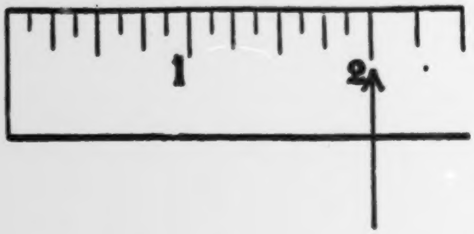
13/32



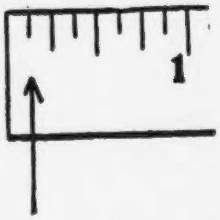
1 5/8



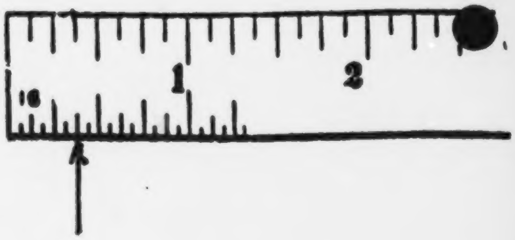
2



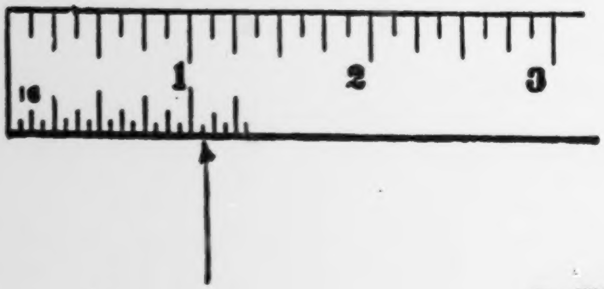
1/8



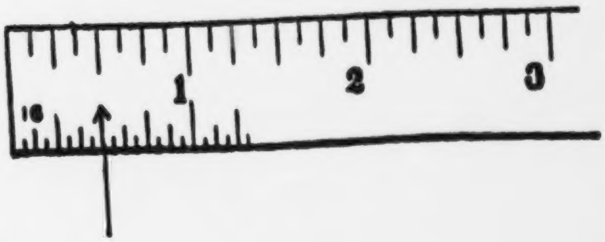
6/16, 3/8



1 1/16



8/16, 4/8, 1/2



APPENDIX (Cont.)

Round these numbers to 3 decimal places:

A.	21,376.4276	**21,376.428**
B.	10.37292	**10.373**
C.	1.2345678	**1.235**
D.	47.7030	**47.703**
E.	98,125.12556	**98,125.126**
F.	2.321212121 2	**2.321**
G.	3.989421	**3.989**
H.	13.1424436	**13.142**
I.	24,388.8752	**24,388.875**
J.	16,235.110527	**16,235.111**

Round these numbers to 4 decimal places:

A.	36,127.15214	**36,127.1521**
B.	1.87842169	**1.8784**
C.	42.495216	**42.4952**
D.	3.78844	**3.7884**
E.	29.1046327	**29.1046**
F.	125,000.00009	**125,000.0001**

MATHEMATICS ON THE JOB I
QUIZ 1

Write the following as whole numbers:

1. Four hundred thousand nine hundred eighty-six

   400,986

2. Seven million eight hundred twenty-one thousand one hundred thirty-three

   7,821,133

3. Two thousand nine hundred fifty-four

   2,954

4. Nine hundred seventy-six billion eight hundred fifty-six million ninety-one thousand forty-four

   976,856,091,044

Put commas in the following numbers:

5. 7,649,083

6. 1,043

7. 567,340

MATHEMATICS ON THE JOB I
QUIZ 1

Add the following numbers:

8.

$$\begin{array}{r} 4 \\ 7 \\ +\ 5 \\ \hline \mathbf{16} \end{array}$$

9.

$$\begin{array}{r} 67 \\ 88 \\ +\ 43 \\ \hline \mathbf{198} \end{array}$$

10.

$$\begin{array}{r} 1{,}276 \\ +\ 7{,}893 \\ \hline \mathbf{9{,}169} \end{array}$$

11.

$$\begin{array}{r} 873 \\ +\ 452 \\ \hline \mathbf{1{,}325} \end{array}$$

12. List all the ways you can think of to change the order of the numbers below according to the commutative property.

6 + 10 + 4

6 + 4 + 10
10 + 6 + 4
10 + 4 + 6
4 + 6 + 10
4 + 10 + 6

MATHEMATICS ON THE JOB I
QUIZ 1

13. Are the following mathematical statements true or false?

a.) 1 + 3 + 5 = 5 + 3 + 1

True

b.) 10 + 17 + 91 = 91 + 17

False

14. List 3 different ways to group the numbers below according to the associative property.

2 + 4 + 8 + 16 + 20

(2 + 4) + (8 + 16 + 20)
(2 + 4 + 8) + (16 + 20)
2 + (4 + 8) + (16 + 20)
(2 + 4) + 8 + 16 + 20
2 + 4 + (8 + 16) + 20
2 + (4 + 8 + 16) + 20
(2 + 4 + 8 + 16) + 20 etc.

15. Are the following mathematical statements true or false?

a.) (9 + 1) + (7 + 10) = 9 + (1 + 7) + 10

True

b.) 17 + 89 + (35 + 76 + 90) = (17 + 89) + 35 + 76 + 90

True

MATHEMATICS ON THE JOB I
QUIZ 1

Subtract the following numbers:

16. $$\begin{array}{r} 78 \\ -\ 42 \\ \hline 36 \end{array}$$

17. $$\begin{array}{r} 919 \\ -\ 765 \\ \hline 154 \end{array}$$

18. $$\begin{array}{r} 16{,}786 \\ -\ 5{,}927 \\ \hline 10{,}859 \end{array}$$

OBJECTIVES

SESSION 6

- **Demonstrate the ability to add and subtract decimals.**
- **Demonstrate the ability to solve decimal word problems involving addition and subtraction.**

MATHEMATICS ON THE JOB I
SESSION 6

WORKING WITH DECIMALS

Using Decimals It may be helpful to point out to participants that we use decimals daily, as we deal with dollars and cents. Decimals are used when a whole is divided into 10 equal parts or into equal parts that are multiples of 10 (such as 100, 1,000). In all cases, assume the decimal point "represents" 1, then add enough zeroes for each place. This number, then, becomes the denominator of the fraction.

Adding and Subtracting Decimals

Example

$$\begin{array}{r} 4.27 \\ .0812 \\ 33.69 \\ +\ 5.1 \\ \hline 43.1412 \end{array}$$

$$\begin{array}{r} 48.734 \\ -\ 5.96 \\ \hline 42.774 \end{array}$$

$$\begin{array}{r} 7.18 \\ -\ 4.235 \\ \hline 2.945 \end{array}$$

Process

1. Arrange numbers in columns so that the decimal points line up.
2. Add or subtract the numbers as if the decimal points were not there. HINT: If there are blanks to the right of some numbers, treat the blanks as zeroes. It may even help you to put zeroes in place of the blanks, especially in subtraction.
3. Bring down the decimal point in the correct column.

MATHEMATICS ON THE JOB I
SESSION 6

Practice **Adding and Subtracting Decimals**

A. 1.375 + .08 + 36.15 = **37.605**

B. 42.1438 + 129.653 + 56.781 = **228.5778**

C. .4912 + .017 + .53 = **1.0382**

D. 2.798 + 35.2 + 4.674 = **42.672**

E. 56.872 - 14.02 = **42.852**

F. 425.68 - 45.926 = **379.754**

G. .37915 - .0150 = **.36415**

H. 2.78315 - .6543 = **2.12885**

I. 9.71 + 4.8 + 3.6 + 19.52 = **37.63**

J. 489.76 + 21.42 + 19.3 + 8.5 = **538.98**

MATHEMATICS ON THE JOB I
SESSION 6

Practice: Adding Decimals

$$\begin{array}{r} 826.28 \\ 53.6 \\ +\ 138.152 \\ \hline 1,018.032 \end{array} \qquad \begin{array}{r} 48.96 \\ 37.42 \\ +\ 99.2 \\ \hline 185.58 \end{array} \qquad \begin{array}{r} 472.1 \\ 81.73 \\ +\ 64.317 \\ \hline 618.147 \end{array}$$

$$\begin{array}{r} 769.0 \\ 406.15 \\ +\ 83.911 \\ \hline 1,259.061 \end{array} \qquad \begin{array}{r} 25.653 \\ 18.92 \\ +\ 46.35 \\ \hline 90.923 \end{array} \qquad \begin{array}{r} 28.776 \\ 14.1 \\ +\ 39.25 \\ \hline 82.126 \end{array}$$

$$\begin{array}{r} 76.5 \\ 89.39 \\ +\ 19.52 \\ \hline 185.41 \end{array} \qquad \begin{array}{r} 34.72 \\ 19.812 \\ +\ 4.6 \\ \hline 59.132 \end{array} \qquad \begin{array}{r} 23.77 \\ 95.3 \\ +\ 4.6 \\ \hline 123.67 \end{array}$$

$$\begin{array}{r} 2.98 \\ 19.52 \\ +\ 14.2 \\ \hline 36.70 \end{array} \qquad \begin{array}{r} 39.765 \\ 8.31 \\ +\ 4.719 \\ \hline 52.794 \end{array} \qquad \begin{array}{r} 489.76 \\ 862.0 \\ +\ 73.25 \\ \hline 1,425.01 \end{array}$$

Subtracting Decimals

Subtraction

Remind the participants that in subtracting, as in adding, the decimal points must line up. If there are insufficient places around the decimal point, then zeroes should be filled in as necessary. Discuss the impact of putting a zero after the decimal point, as opposed to after the number but before the decimal point. For example, the class will know the difference between adding a zero to $2.00 to make $20.00, and adding a zero to $0.2 to make $0.20.

Practice

Remember to line up the decimal points!

A. 58.9 - 36.7 = **22.2**

B. 146.35 - 58.98 = **87.37**

C. 28.362 - 16.5 = **11.862**

D. 59.7 - 38.914 = **20.786**

E. 11.813 - 6.425 = **5.388**

F. 35.15 - 19.37 = **15.78**

G. 28.937 - 15.82 = **13.117**

MATHEMATICS ON THE JOB I
SESSION 6

Practice: Subtracting Decimals

73.5 - 19.2 **54.3**	47.8 - 36.5 **11.3**	112.2 - 96.5 **15.7**
381.8 - 87.9 **293.9**	283.54 - 18.77 **264.77**	49.253 - 8.714 **40.539**
15.7 - 2.852 **12.848**	36.9 - 14.582 **22.318**	72.89 - 27.654 **45.236**

Instructor Note: The decimal points in the following problems are not lined up. The participant must line them up manually.

479.3 - 85.793 **393.507**	285.4 - 56.932 **228.468**	18 - .896 **17.104**
39.8 - 27.42 **12.38**	596.8 - 14.398 **582.402**	578.49 - 69.8 **508.69**
47.658 - 19.7 **27.958**	85.751 - 20.9 **64.851**	472.700 - 27.6 **445.100**

Additional problems can be found in the Appendix at the end of this chapter.

4. Gloria Marichales studies Accounting at Cuyahoga Community College and needs 6 more courses to get her degree. She currently works in Accounts Payable, and wrote checks today for $172.15, $89.06, $122.43 and $19.25. Find the total of the checks.

   $172.15 + $89.06 + $122.43 + $19.25 = $402.89

5. Tom Lewis made $254.19 at the regular rate of pay and $76.49 at the overtime rate. In spite of the bigger checks he can bring home, he constantly argues with his wife about the amount of overtime he works. His tax deduction was $49.602. How much was his take-home pay?

   $254.19 + $76.49 = $330.68 gross pay

   $330.68 pay - $49.602 tax deduction = $281.078 take-home pay

   Note: Because this is in dollars, be sure the class rounded to 2 decimal places. His take-home pay was actually $281.08.

   Also point out that the arguments with his wife do not affect this problem.

6. The Kirby Company sent in a check for $38,427.19 in payment of invoice #12470. The payment was received 10 days late. However, the invoice amount was actually $38,247.19. How much should CWP return to the Kirby Company?

   $38,427.19 - $38,247.19 = $180 or $180.00

7. Cleveland Wood Products has been having a lot of trouble with its towmotors recently. They received a repair bill from The Towmotor Repair and Replacement Company for $2,835.76. Of that amount, $937.45 was for parts. How much did the labor cost?

   $2,835.76 - $937.45 = $1,898.31

8. At the beginning of March, the odometer of Dorothy Raymond's company car read 29,086.1 miles. At the end of March, it read 31,561.9 miles. How many miles did Ms. Raymond drive during the month?

31,561.9 miles - 29,086.1 miles = 2,475.8 miles

9. Refer to the problem above. Suppose that in March, Ms. Raymond drove the car 897.4 miles on personal business. How many miles was the car driven on company business?

2,475.8 miles - 897.4 miles = 1,578.4 miles

10. On February 1, The Brusch Company had $15,009.30 in its checking account. The Accounting Department transferred $5,637.99 to the savings account the next day. The Payroll Department is behind in its work by one week, and some workers did not get paid last week. After the transfer, how much did the Brusch Company have in its checking account?

$15,009.30 - $5,637.99 = $9,371.31

Point out that the fact that some workers did not get paid last week does not change the numbers in this problem. (That is a whole separate issue.)

Additional word problems can be found in the Appendix at the end of this chapter.

MATHEMATICS ON THE JOB I
SESSION 6

APPENDIX

Practice: Adding Decimals

A. 4.98 + 2.17 = **7.15**

B. 13.761 + 8.325 = **22.086**

C. 17.921 + 111.1 = **129.021**

D. 6.54 + 9.8 = **16.34**

E. 12.94 + 6.083 + 74.1 = **93.123**

F. 398.81 + 47.658 + 4,158.7 = **4,605.168**

G. 3,217.6 + 895.41 + 37.288 = **4,150.298**

H. 65.2 + 174.08 + 16.825 = **256.105**

I. 7.5 + 9.83 = **17.33**

J. 74 + 9.71 + 107.325 = **191.035**

MATHEMATICS ON THE JOB I
SESSION 6

APPENDIX (Cont.)

Practice: Adding and Subtracting Decimals

Instructor Note: The decimal points on this page are not lined up; the participants must do this themselves. You may wish to allow participants to use calculators to do Appendix problems, since effective and accurate use of a calculator is one of the goals of this course.

19.74	27.8	786.1
- 6.58	- 23.605	- 4.271
13.16	**4.195**	**781.829**
386.021	221.04	128.3506
59.8	20.36	15
+ 2.500	+ 1.3700	+ 803.25
448.321	**242.7700**	**946.6006**
8.34	4.2	114.809
- 5	- 1.379	- .69815
3.34	**2.821**	**114.11085**
786.1	89.06	31.742
6.58	8.39	23.70
+ 1.2	+ 39.083	+ 3.2781
793.88	**136.533**	**58.7201**

MATHEMATICS ON THE JOB I
SESSION 6

APPENDIX (Cont.)

Decimal Word Problems

1. Julio Gonzalez needed some office supplies and could not wait for the ordinary CWP supplier to deliver them. So he went to Office Maxx and bought $31.09 worth of supplies, which he paid for with a $50 bill from Petty Cash. How much change did he get?

$50.00 - $31.09 = $18.91

2. Howard Smith needs to file his expense account report. He spent 1 night at the Macon Holiday Inn at $67.46 per night and rented a car for the weekend at a rate of $49.95. (All mileage was included in this rate.) He drove the car 916 miles. He spent 1 night with a relative in Atlanta to save the company a night of hotel expense. His meal expense was $59.86 the first day and $37.25 the second day. How much will the company reimburse him?

$67.46 hotel + $49.95 rental car + $59.86 first day meals + $37.25 second day meals = $214.52

3. The Keller Company's bank statement showed a balance of $24,367.49 at the beginning of the month. During the month the following deposits were made: $183.50, $2,333.75, and $780.86. Also this month, the following checks were written: $2,715.50, $860.94, $16,735, and $953. Find the Keller Company's end of the month balance.

$24,367.49 + $183.50 + $2,333.75 + $780.86 - $2,715.50 - $860.94 - $16,735.00 - $953.00 = $6,401.16

APPENDIX (Cont.)

Decimal Word Problems

4. Cleveland Wood Products asks that its salesmen use company credit cards to fill the tanks of company cars. The following receipts for gasoline purchases were turned in during the past month:

Amount Purchased	Number of Gallons
$11.98	11.2
$12.10	10.8
$16.22	14.1
$9.40	9.4
$7.04	6.7

How many gallons were purchased during this month? What was the total amount of the purchases?

11.2 gallons + 10.8 + 14.1 + 9.4 + 6.7 = 52.2 gallons purchased

$11.98 + $12.10 + $16.22 + $9.40 + $7.04 = $56.74

5. The perimeter of a triangle is found by adding the lengths of all the sides together. If a triangle has the following sides, what is the perimeter? 4.5 inches, 3.75 inches, 5.125 inches.

4.5 inches + 3.75 inches + 5.125 inches = 13.375 inches

6. Find the perimeter of a box which measures 10.5 inches by 3.75 inches.

10.5 inches + 10.5 inches + 3.75 + 3.75 = 28.5 inches

APPENDIX (Cont.)

Decimal Word Problems

7. A carpenter has to make some storage shelves for the Paint Department. Unfortunately, the power saw is broken and he will have to cut the shelves with a regular saw, which is more difficult and will take more time. The carpenter has a 16-foot board he is going to use. He wants to make 2 shelves which each measure 3.75 feet. How much wood will be left after he cuts the 2 shelves?

   16 feet - 3.75 feet - 3.75 feet = 8.5 feet

8. An executive needs to take a business trip, and decides to travel by car. He drove 4.5 hours on Monday, 12.75 hours Tuesday, 8.33 hours on Wednesday, and 15.125 hours on Thursday. What was his total driving time for the trip?

   4.5 hours + 12.75 hours + 8.33 hours + 15.125 hours = 40.705 hours

9. The company is installing new carpeting in the offices of the plant. The plant manager's office required 20.5 square yards of carpet, the secretary's office required 8.75 square yards, and the Accounting Department required 32.125 square yards. How much carpet was purchased, assuming there was no waste in cutting it to the appropriate size? If 3.25 square yards were wasted in the cutting, how much carpet would have to be purchased?

   Assuming no waste: 20.5 square yards + 8.75 square yards + 32.125 square yards = 61.375 square yards

   Assuming 3.25 square yards of waste: 61.375 square yards + 3.25 square yards = 64.625 square yards

10. A dowel was required to be cut to 8.125 inches. However, by accident, the worker, who was new, misread the order and cut it to 7.625 inches. How much too short was the dowel?

    8.125 inches - 7.625 inches = 0.5 inch too short

OBJECTIVES

SESSION 7

- Demonstrate the ability to multiply and divide decimals.
- Demonstrate the ability to solve decimal word problems involving multiplication and division.

MATHEMATICS ON THE JOB I
SESSION 7

WORKING WITH DECIMALS

Multiplying Decimals

Overview You may want to tell the participants, by way of an overview of this session, that when multiplying and dividing, it is not necessary to line up the decimal points. Rather, you perform the math without regard to the decimal point, and then count up the decimal places to determine where the place the decimal point.

Example

$$\begin{array}{r} 2.65 \\ \underline{\times\ 3.3} \\ 795 \\ \underline{795\ \ } \\ 8.745 \end{array}$$

$$\begin{array}{r} .014 \\ \underline{\times\ .51} \\ 014 \\ \underline{070\ \ } \\ .00714 \end{array}$$

Process

1. Multiply the numbers first as if there were no decimal points.
2. Count the number of decimal places in the top number.
3. Count the number of decimal places in the bottom number.
4. Add the number of decimal places in the two numbers together.
5. Starting from the right, count over the same number of digits as the total number of decimal places in the numbers in the problem. Place your decimal point to the left of the digit.

NOTE: If there are not enough digits, you'll need to add zeroes to the left of the number.

MATHEMATICS ON THE JOB I
SESSION 7

Multiplying Decimals

$$\begin{array}{r} 39.6 \\ \times\ 4.8 \\ \hline 3168 \\ 1584 \\ \hline 190.08 \end{array}$$

$$\begin{array}{r} 18.7 \\ \times\ 2.3 \\ \hline 561 \\ 374 \\ \hline 43.01 \end{array}$$

$$\begin{array}{r} 47.63 \\ \times\ 2.61 \\ \hline 4763 \\ 28578 \\ 9526 \\ \hline 124.3143 \end{array}$$

$$\begin{array}{r} 21.43 \\ \times\ 12.15 \\ \hline 10715 \\ 2143 \\ 4286 \\ 2143 \\ \hline 260.3745 \end{array}$$

$$\begin{array}{r} 65.3 \\ \times\ 4.6 \\ \hline 3918 \\ 2612 \\ \hline 300.38 \end{array}$$

$$\begin{array}{r} 7.51 \\ \times\ 8.2 \\ \hline 1502 \\ 6008 \\ \hline 61.582 \end{array}$$

$$\begin{array}{r} 280.9 \\ \times\ 6.85 \\ \hline 14045 \\ 22472 \\ 16854 \\ \hline 1{,}924.165 \end{array}$$

$$\begin{array}{r} 73.52 \\ \times\ 2.34 \\ \hline 29408 \\ 22056 \\ 14704 \\ \hline 172.0368 \end{array}$$

$$\begin{array}{r} .093 \\ \times\ 5.6 \\ \hline 0558 \\ 0465 \\ \hline 0.5208 \end{array}$$

$$\begin{array}{r} .042 \\ \times\ 3.2 \\ \hline 0084 \\ 0126 \\ \hline 0.1344 \end{array}$$

$$\begin{array}{r} .571 \\ \times\ 2.9 \\ \hline 5139 \\ 1142 \\ \hline 1.6559 \end{array}$$

$$\begin{array}{r} 21.7 \\ \times\ 6.1 \\ \hline 217 \\ 1302 \\ \hline 132.37 \end{array}$$

MATHEMATICS ON THE JOB I
SESSION 7

Dividing Decimals

Examples

9.7
2.14 |20.758
- 19 26
1498
- 1498
0

2.037
4.22 |8.60000
- 844
160
- 0
1600
- 1266
3340
- 2954
386

Process

1. Eliminate the decimal point in the divisor by moving it the required number of places to make it a whole number.
2. Move the decimal point in the dividend the same number of decimal places as you did for the divisor. (You're not trying to make this number a whole number.)

   NOTE: If there are not enough places, you may need to add digits to the right of the dividend.
3. Divide as you would if there were no decimal points. Be sure to keep your numbers lined up.
4. Place the decimal point in the quotient directly above the moved decimal point in the dividend. This should be easy if your digits are correctly lined up.

MATHEMATICS ON THE JOB I
SESSION 7

Practice: Multiplying and Dividing Decimals

A. .375 x 2.9 = **1.0875**

B. 22.450 x .56 = **12.572**

C. 77.35 x 2.5 = **193.375**

D. .4187 x .358 = **.1498946**

Note: Please tell students to round their division answers to 2 or 3 decimal places. However, for the answer key, the full answer is provided.

E. 36 ÷ .47 = **76.595744**

F. 6.2812 ÷ 2.3 = **2.7309565**

G. 127.91 ÷ 3.36 = **38.068452**

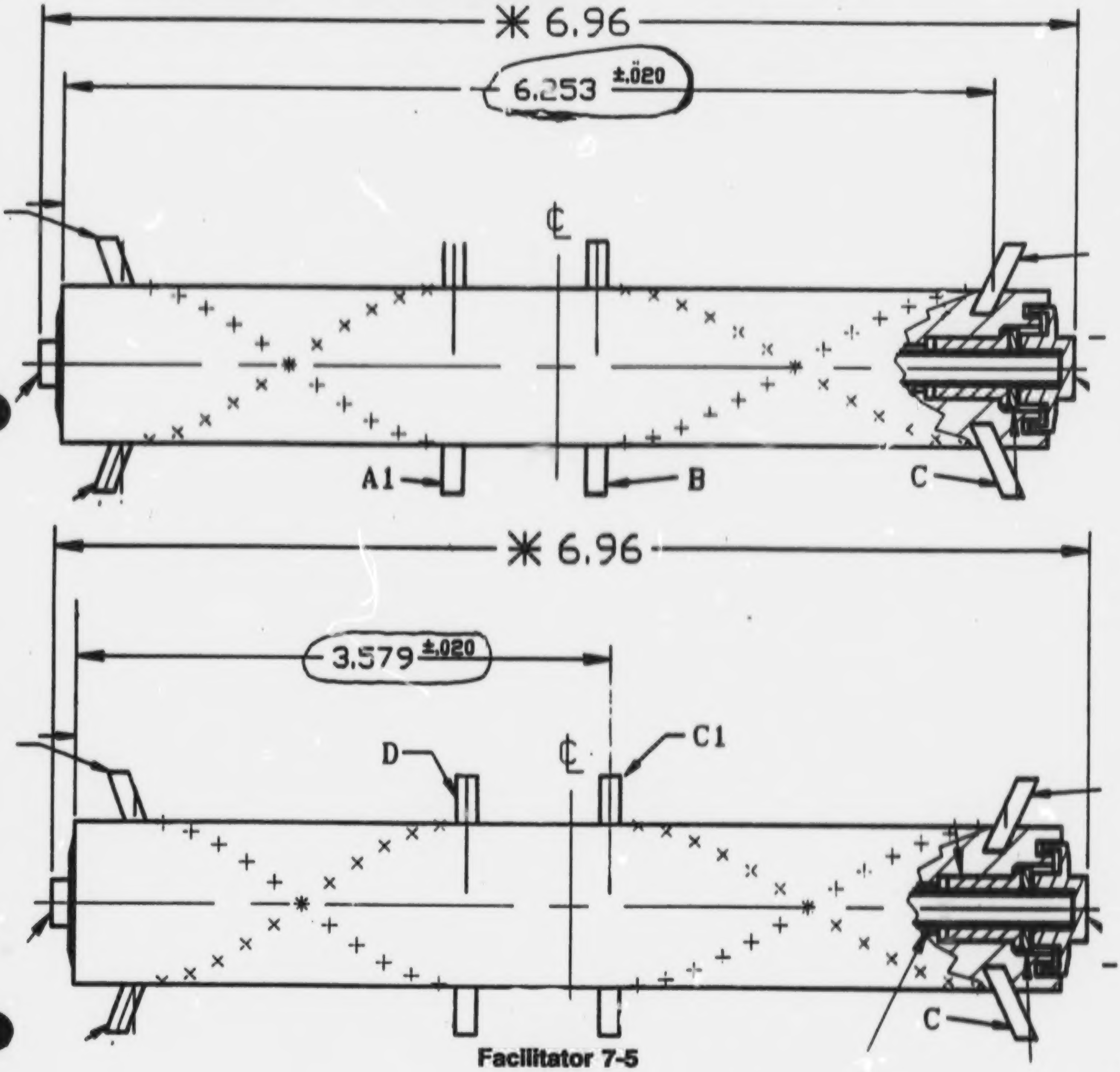
H. 4.9 ÷ .715 = **6.8531468**

MATHEMATICS ON THE JOB I
SESSION 7

Practice: Word Problems

1. Find the upper and lower tolerances of the circled dimensions.

6.253 + .020 = 6.273 Upper tolerance
6.253 - .020 = 6.233 Lower tolerance

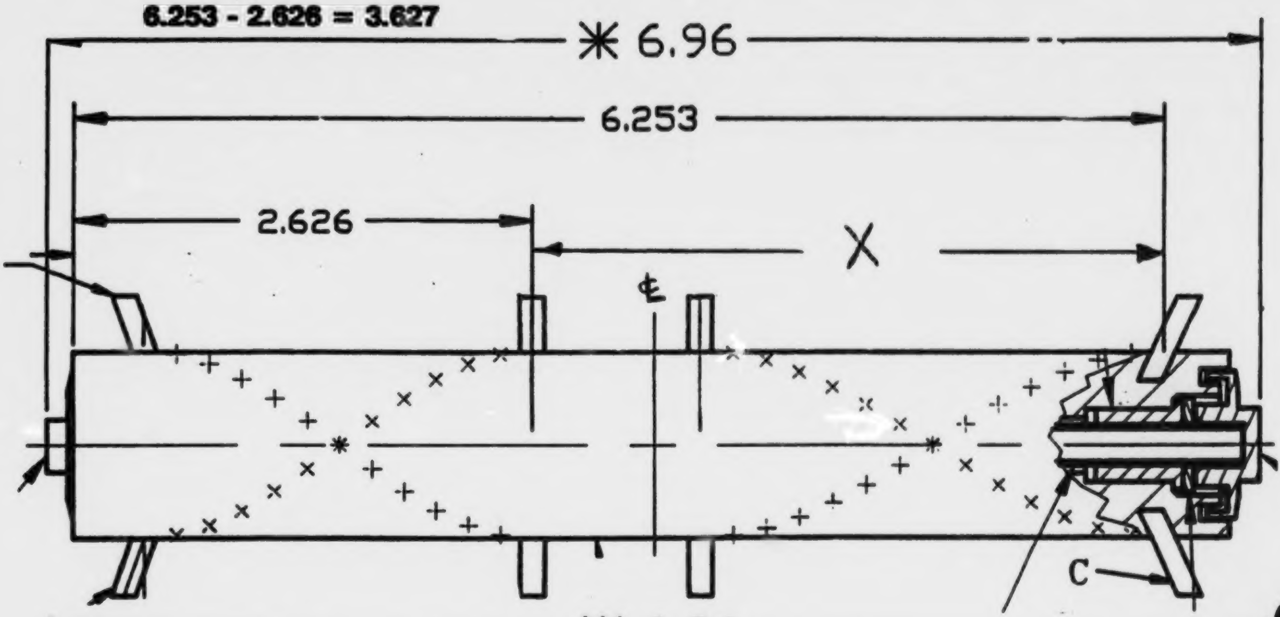

✳ 6.96
6.253 ±.020
℄
A1
B
C
✳ 6.96
3.579 ±.020
D
℄
C1
C

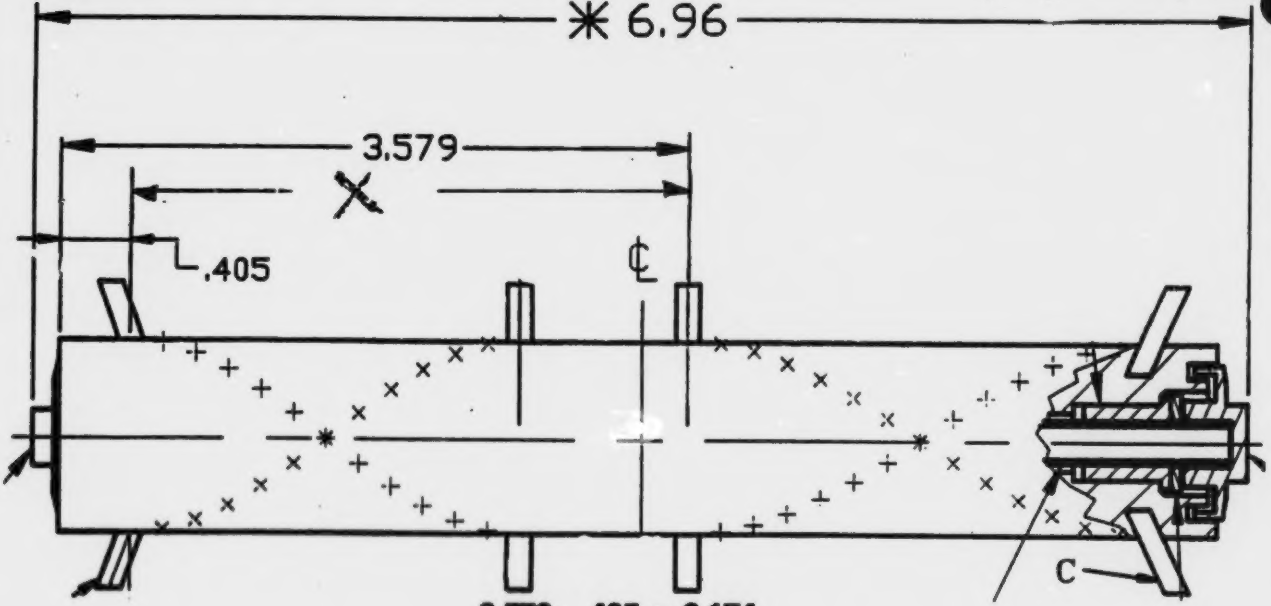
Facilitator 7-5

3.579 + .020 = 3.599
3.579 - .020 = 3.559

2. **Find the X dimensions of each of the drawings below.**

6.253 - 2.626 = 3.627


✳ 6.96
6.253
2.626
X
℄
C


✳ 6.96
3.579
X
.405
℄
C

3.579 - .405 = 3.174

3. A worker finally gets a $ .75 per hour raise. How much more money will this mean on a 2 week payroll period of 79.25 hours. (Round to 2 decimal places.)

$.75 x 79.25 hours = $59.44

4. The dowel should have been cut to 5.376", however, when it was measured, it was actually 6.001". What was the difference?

6.001 inches - 5.376 inches = 0.625 inches

5. One dowel is 7.55 inches thick and another is 6.5 inches thick. How much thinner is the second dowel than the first?

7.55 inches - 6.5 inches = 1.05 inches

Appendix
Additional Word Problems

4. A piece of wood 10.987 feet long is to be cut into 1.55 foot long pieces. How many pieces of the proper size can be cut from the wood?

10.987 total length of wood / 1.55 feet per piece = 7.088 pieces

5. A piece of wood 4.6 feet long is to be cut into 42 pieces of equal length. How many inches long will each piece be?

4.6 feet x 12 inches per foot = 55.2 inches

55.2 inches / 42 pieces = 1.314 inches

6. If your reject rate is .026, how many dirt magnets will be rejected out of a run of 573?

573 total dirt magnets x .026 = 14.898 dirt magnets

MATHEMATICS ON THE JOB I
SESSION 7

Appendix
Additional Word Problems

7. Laura's reject rate is .11. How many brushroll assemblies can she expect to reject out of a total of 350?

   350 total brushroll assemblies x .11 = 38.5 brushroll assemblies

8. Downtime on Sam's center boring machine decreased by .03. If his machine used to be down about 40 minutes per shift, how many minutes will his machine be down after the decrease?

   Previous downtime: 40 minutes per shift
   Decreased by .03

   40 minutes x .03 = 1.2 minutes less downtime

   40 minutes old rate - 1.2 minutes saved = 38.8 minutes

9. Ed produces 1.5 times as many dirt magnets as Martha. If Martha produces 211 dirt magnets per hour, how many dirt magnets per hour does Ed produce?

   211 x 1.5 times = 316.5 dirt magnets

MATHEMATICS ON THE JOB I
SESSION 7

APPENDIX
Additional Word Problems

1. Cleveland Wood Products needs to purchase the following office equipment and supplies: two new typewriters costing $1,463.58 each, four calculators at $10.65 and three cases of copier paper at $89.95 each. There is a 7% (.07) sales tax. What is the total price of the office equipment and supplies?

Typewriters: 2 x $1,463.58 = $2,927.16
Calculators: 4 x $10.65 = $42.60
Copier paper: 3 x $89.95 = $269.85

Add cost of equipment/supplies: $3,239.61
Add 7% sales tax (round to nearest cent): .07 x $3,239.61 = $226.77

Total cost = $3,239.61 + $226.77 tax = $3,466.38

Now try this calculator sequence, using the memory key.

- **Calculate cost of typewriters, and enter into memory**
- **Calculate cost of calculators, recall cost of typewriters and add it, then save the cost of both together.**
- **Calculate cost of paper, recall cost of typewriters and calculators, and add it to the paper cost. Save the result.**
- **Calculate tax, recall cost and add it to the tax. This is your answer.**

2. The office staff also needs some miscellaneous supplies: 3 dozen Pilot pens at $1.39/pen, a new pencil sharpener at $17.55, and 12 new calendars for next year, at $7.99 each. Sales tax is 7% (.07). What will be the total bill?

Pens: 36 x $1.39 = $50.04
Pencil Sharpener: $17.55
Calendars: 12 x $7.99 = $95.88

Total cost of supplies: $50.04 + $17.55 + $95.88 = $163.47
Tax (round to nearest cent): $.07 x $163.48 = $11.44

Total bill: $163.47 + $11.44 tax = $174.91

MATHEMATICS ON THE JOB I
SESSION 7

APPENDIX
Additional Word Problems

3. To find the monthly interest due on a building owned by Epsilon Company, multiply the mortgage balance by .007292. Find the monthly interest on a mortgage having a balance of $242,798.46.

   $242,798.46 x .007292 = $1,770.49

4. All employees at Seaview Market are hired to work a 40-hour week. If an employee works more than 40 hours a week, the employee is paid 1.5 times the regular hourly rate. For each employee, find the gross pay for the week.

Employee	Hours Worked	Hourly Rate	Gross Pay
Nicole	49.5	$ 8.25	**(40 x $8.25) + (9.5 x $12.38) = $447.61**
Carole	51	$12.74	**(40 x $12.74) + (11 x $19.11) = $719.81**
Thelma	54.6	$10.80	**(40 x $10.80) + (14.6 x $16.20) = $668.52**
Carlos	58.2	$14.35	**(40 x $14.35) + (18.2 x $21.53) = $965.85**

MATHEMATICS ON THE JOB I
SESSION 7

APPENDIX
Additional Word Problems

5. At the company picnic, one of the activities was a Mock Olympics. Results are given below:

Event	**Participant**	**Score**
Long jump	Stephanie	23 feet 5 inches
	Kurt	19 feet 3 inches
	Elena	24 feet
High jump	Maria	6 feet 1 inch
	Alex	5 feet 4 inches
	Mark	5 feet 1 inch
Crab walk	Juanita	2 minutes 35 seconds
	Julie	1 minutes 59 seconds

a. How much further did Stephanie jump than Kurt jumped? (Express your answer in decimal form rounded to 2 places.)

5/12 = .4166 = .42 **Stephanie jumped 23.42 feet.**
3/12 = .25 **Kurt jumped 19.25 feet.**
23.42 feet - 19.25 feet = 4.17 feet further

b. How much less did Mark jump than Alex? (Express your answer in decimal form rounded to 2 places.)

1/12 = .0833 = .08 **Mark jumped 5.08 feet.**
4/12 = .3333 = .33 **Alex jumped 5.33 feet.**
5.33 feet - 5.08 feet = 0.25 feet less

c. How much faster did Julie finish the Crab walk than Juanita? (Express your answer in decimal form rounded to 2 places.)

35/60 = .5833 = .58 **Juanita finished in 2.58 minutes.**
59/60 = .9833 = .98 **Julie finished in 1.98 minutes.**
2.58 minutes - 1.98 minutes = 0.6 minutes faster

CLEVELAND WOOD PRODUCTS

MATHEMATICS ON THE JOB I

OBJECTIVES

SESSION 8

- Demonstrate the ability to convert between percents and decimals.
- Demonstrate the ability to use a calculator to solve decimal and percent word problems involving various operations.

MATHEMATICS ON THE JOB
SESSION 8

DECIMALS AND PERCENTS

What is a Percent?

Introduction

A percent is a **fraction** that always has 100 as a denominator. To indicate that a number is a percent, a percent sign (%) is used. **You can easily remember that the denominator = 100, because the % sign looks like a number 1 between 2 zeroes. Any percent higher than 100 indicates a whole number, and may or may not include a fractional part.**

How many hundredths does each percent below indicate?

24%	**24/100ths**
75%	**75/100ths**
8.9%	**8.9/100ths**
1/2%	**.5/100ths**
49%	**49/100ths**
5.7%	**5.7/100ths**
4.5%	**4.5/100ths**
80.4%	**80.4/100ths**
62%	**62/100ths**
82%	**82/100ths**
52.8%	**52.8/100ths**
700%	**700/100ths**

Instructor Note:

Point out that 700/100 is greater than 1. Reduce it on the board to the whole number 7 by canceling out the 2 zeroes in both the numerator and denominator.

MATHEMATICS ON THE JOB
SESSION 8

Converting Decimals to Percents

Procedure

To convert a decimal to a percent, move the decimal point 2 places to the **right** and add the percent sign (%). It is quite possible that you do not have 2 places to the right of the decimal point. In that case, just add zeroes until you get 2 places. Remember that **any percent greater than 100 represents a whole number,** and may or may not include a fractional part.

Instructor Note:

Please do not allow participants to use their calculators until you come to the part of the session labeled Using a Calculator. It is important that they understand the logic behind these conversions.

Examples

Convert the following decimal numbers to percents.

.86 = **86%**   0.62 = **62%**

.97543 = **97.543%**   0.06 = **6%**

0.8 = **80%**   1.4 = **140%**

Instructor Note:

Point out that the above 2 examples do not have sufficient decimal places after the point; in each case, one zero must be added.

Practice

Convert the following decimal numbers to percents:

0.17 = **17%**   0.201 = **20.1%**

0.005 = **.5%**   9.5 = **950%**

0.37 = **37%**   0.318 = **31.8%**

5.01 = **501%**   0.047 = **4.7%**

MATHEMATICS ON THE JOB
SESSION 8

Converting Percents to Decimals

Procedure

To convert a percent to a decimal, just move the decimal point 2 places to the left and drop the percent sign. If you do not have 2 places in the percent, add as many zeroes as you need, and then put in the decimal point.

Instructor Note

You may need to remind the participants that if there is no decimal point showing in the percent, it is understood to be after the number and before the % sign.

Examples

Convert the following percents to decimals.

A. 89.75% = **.8975**

B. 70% = **.7**

C. 159% = **1.59**

D. 6.9% = **.069**

E. 3% = **.03**

F. 67% = **.67**

Practice

Convert each of the following percents to decimals.

A. 4% = **.04**

B. 110% = **1.10**

C. 356% = **3.56**

D. 85% = **.85**

E. 9.5% = **.095**

F. 53% = **.53**

G. 350% = **3.5**

H. 0.27% = **.0027**

I. 215% = **2.15**

J. 32% = **.32**

K. 6.5% = **.065**

L. 1% = **.01**

MATHEMATICS ON THE JOB
SESSION 8

Calculator Practice

Procedure (Manual)

When you find a percent of a number manually, you need to change the percent to a decimal, and then multiply the decimal by the other number. For example, to figure out what 12% of 125 is, follow this process:

A. Change the percent to a decimal number:

12% = **.12**

B. Multiply the decimal number by the other number in the problem:

.12 x 125 = **15**

C. Therefore, 12% of 125 = 15.

Using a Calculator

Your calculator has a % sign. To calculate 15% of 125, press the 1, 5 and the % key. Display will show the number that is 15% of 125. Try these sample problems:

A. 6% of 29 = **1.74**

B. 5% of 67 = **3.35**

C. 12% of 72 = **8.64**

D. 50% of 19 = **9.5**

E. 78% of 40 = **31.2**

F. 13% of 84 = **10.92**

G. 60% of 29 = **17.4**

H. 54% of 60 = **32.4**

MATHEMATICS ON THE JOB
SESSION 8

WORD PROBLEMS
Percent and Decimals

Practice: **Do these problems together in class. It may be helpful to review the 5 steps for solving word problems. The use of calculators is recommended, as some of these problems are difficult, and it is preferable that the participants concentrate on the process and logic rather than the mechanics. Have participants calculate the percentage of, using the percent key, then use the +/- key to change the sign, then add the original price.**

The Brandt Company is a supplier of office equipment and supplies. It recently sent a letter to all its customers describing a sale that the company is going to have. Listed below are the regular prices of several items, along with the discount prices. In each case, write the sale price of the item.

Item Number	Regular Price	Discount Percent	Calculation
123	$20.37	20%	**20% x $20.37 = $4.07 discount** **$20.37 - $4.07 = $16.296**
456	$125.79	15%	**15% x $125.79 = $18.87 discount** **$125.79 - $18.87 = $106.92**
789	$3,274.60	10%	**10% x $3,274.60 = $327.46** **$3,274.60 - $327.46 = $2,947.14**
376	$278.89	25%	**25% x $278.89 = $69.72** **$278.89 - $69.72 = $209.17**

MATHEMATICS ON THE JOB
SESSION 8

APPENDIX

Restating Percents as Fractions

How many hundredths are in each percent given below?

A. 900% = **900/100**

B. 175% = **175/100**

C. 8.75% = 8.75/100

D. 56% = **56/100**

E. 0.35% = **.35/100**

F. 6% = **6/100**

G. 7.2% = **7.2/100**

H. 110% = **110/100**

I. .5% = **.5/100**

J. 52.8% = **52.8/100**

K. 79% = **79/100**

L. 1.5% = **1.5/100**

M. 13.2% = **13.2/100**

N. 0.8% = **.8/100**

O. 91% = **91/100**

P. 5% = **5/100**

Q. 0.52% = **.52/100**

R. 8.1% = **8.1/100**

S. 0.6% = **.6/100**

T. 11.5% = **11.5/100**

U. 82% = **82/100**

V. 130% = **130/100**

W. 6.25% = **6.25/100**

X. 0.3% = **.3/100**

Y. 5.75% = **5.75/100**

Z. 4.09% = **4.09/100**

MATHEMATICS ON THE JOB
SESSION 8

APPENDIX

Restating Decimal Numbers to Percents

Restate each decimal number as a percent.

A. 1.5 = **150%**

B. 2.36 = **236%**

C. 0.01 = **1%**

D. 0.11 = **11%**

E. 0.0323 = **3.23%**

F. 0.002 = **.2%**

G. 0.626 = **62.6%**

H. 0.56 = **56%**

I. 0.464 = **46.4%**

J. 3.7 = **370%**

K. 0.18 = **18%**

L. 0.2313 = **23.13%**

M. 0.007 = **.7%**

N. 0.131 = **13.1%**

O. 0.907 = **90.7%**

P. 0.999 = **99.9%**

Q. 0.39 = **39%**

R. 0.88 = **88%**

S. .125 = **12.5%**

T. 0.07 = **7%**

U. 0.907 = **90.7%**

V. 0.85 = **85%**

W. 6.5 = **650%**

X. 0.4 = **40%**

Y. 0.551 = **55.1%**

Z. 0.0035 = **.35%**

MATHEMATICS ON THE JOB
SESSION 8

APPENDIX

Restating Decimal Numbers to Percents

Restate each decimal number as a percent.

A. 0.5545 = **55.45%**

B. 0.6 = **60%**

C. 0.77 = **77%**

D. 7.2 = **720%**

E. 0.09 = **9%**

F. 0.625 = **62.5%**

G. 0.41 = **41%**

H. 0.29 = **29%**

I. 4.92 = **492%**

J. 0.0061 = **.61%**

K. 0.91 = **91%**

L. 0.894 = **89.4%**

M. 0.03 = **3%**

N. 0.6623 = **66.23%**

O. 0.84 = **84%**

P. 0.411 = **41.1%**

Q. 0.08 = **8%**

R. 0.004 = **.4%**

S. 0.51 = **51%**

T. 8.25 = **825%**

U. 0.5 = **50%**

V. 0.0413 = **4.13%**

W. 0.73 = **73%**

X. 0.05 = **5%**

Y. 0.008 = **.8%**

Z. 0.44 = **44%**

MATHEMATICS ON THE JOB
SESSION 8

APPENDIX

Restating Percents as Decimals

Restate each percent as a decimal.

A. 605% = **6.05**

B. 95% = **.95**

C. 700% = **7.00**

D. 8.5% = **.085**

E. 9% = **.09**

F. 12.7% = **.127**

G. 99% = **.99**

H. 80.4% = **.804**

I. 13% = **.13**

J. 800% = **8.00**

K. 6.23% = **.0623**

L. 41% = **.41**

M. 0.15% = **.0015**

N. 5.13% = **.0513**

O. 0.01% = **.0001**

P. 147% = **1.47**

Q. 4% = **.04**

R. 100.5% = **1.005**

S. 3.5% = **.035**

T. 80% = **.80**

U. 150% = **1.50**

V. 1.25% = **.0125**

W. 1.2% = **.012**

X. 14% = **.14**

Y. 64% = **.64**

Z. 2.5% = **.025**

MATHEMATICS ON THE JOB
SESSION 8

APPENDIX

Restating Percents as Decimals

Restate each percent as a decimal number.

A. 125% = **1.25**

B. 0.92% = **.0092**

C. .75% = **.0075**

D. 0.9% = **.0009**

E. 35% = **.35**

F. 7.25% = **.0725**

G. 8% = **.08**

H. 300% = **3.00**

I. 0.1% = **.001**

J. 91.8% = **.918**

K. 620% = **6.20**

L. 9.5% = **.095**

M. 7% = **.07**

N. 0.21% = **.0021**

O. 4.09% = **.0409**

P. 5.75% = **.0575**

Q. 0.3% = **.003**

R. 6.25% = **.0625**

S. 130% = **1.30**

T. 82% = **.82**

U. 11.5% = **.115**

V. 8.1% = **.081**

W. 0.52% = **.0052**

X. 5% = **.05**

Y. 91% = **.91**

Z. 0.8% = **.008**

MATHEMATICS ON THE JOB
SESSION 8

APPENDIX

Calculator Practice

Using your calculator, work each problem.

Instructor Note: Point out that if you take a greater percentage than 100% of another number, your answer will be larger than the number you started with.

A. 7% of 7.2 = **.504**

B. 4% of 9.6 = **.384**

C. 8% of 75.3 = **6.024**

D. 9% of 61.5 = **5.535**

E. 45% of 3.7 = **1.665**

F. 62% of 0.93 = **.5766**

G. 3.5% of 70 = **2.45**

H. 4.2% of 39 = **1.638**

I. 9.2% of 28 = **2.576**

J. 4.5% of 90 = **4.05**

K. 0.7% of 82 = **0.574**

L. 0.5% of 35 = **0.175**

M. 7.6% of 260 = **19.76**

N. 5.8% of 430 = **24.94**

O. 2.75% of 95 = **2.6125**

P. 6.25% of 75 = **4.6875**

Q. 150% of 40 = **60**

R. 125% of 40 = **50**

MATHEMATICS ON THE JOB
SESSION 8

APPENDIX

Percent and Decimal Word Problems

The Splitz Hardware Company is a supplier of paint and related supplies for smaller companies. It is going out of business, however, and has to liquidate all its inventory. The Office Manager of Abdec Company recently went to their warehouse and found the following sale prices indicated on signs. Listed below are the regular prices of several items, along with the discount prices. In each case, write the sale price of the item.

Item Number	**Regular Price**	**Discount Percent**	**Calculation**
A 320	$59.37	20%	**20% x $59.37 = $11.87 discount** **$59.37 - $11.87 = $47.50**
B 784	$15.34	12%	**12% x $15.34 = $1.84** **$15.34 - $1.84 = $13.50**
C 120	$42.76	35%	**35% x $42.76 = $14.97** **$42.76 - $14.97 = $27.79**
D 997	$132.49	49%	**49% x $132.49 = $64.92** **$132.49 - $64.92 = $67.57**

APPENDIX

Percent and Decimal Word Problems

1. Carmen earns $6.45 an hour. She gets 5 sick days a year, and 2 weeks of vacation. How much does she earn in a 7 1/2 hour day?

   $6.45 x 7.5 = $48.38

   Point out that the number of sick days and vacation weeks is irrelevant to this problem.

2. Find the cost of 2.75 gallons of paint at $24.39 a gallon. Spill-clean, used only occasionally in the paint shop, costs $35.00.

   2.75 x $24.39 = $67.07

   Point out that the cost of Spill-clean is irrelevant to this problem.

3. A survey at an intersection found that approximately 25 children were not riding in children's carseats. Of 2,200 drivers, 38% were wearing seat belts. How many drivers in the survey were wearing seat belts?

   38% x 2,200 = 836 drivers were wearing seat belts.

   Point out that the unrestrained children do not affect the calculation of this problem.

APPENDIX

Decimal and Percent Word Problems

4. The Solar Bank offers scholarships to children of its employees. This year there were 37 applicants. However, only 25% of the applicants met the stated qualifications. How many applicants met the requirements?

   25% x 37 = 9.25 students, which rounds to 9.

   Be sure participants understand that sometimes they need to use logic as to when it is appropriate to round off the answer. In this case, you cannot have .25 of a student.

5. At the State Stationery Company, 48% of the 160 employees carry medical benefits for their family. 15% do not have any medical coverage at all through this company.

   How many employees have only single coverage? How many employees carry family coverage?

   Single coverage:

   100% - 48% - 15% = 37% of employees have single coverage

   37% x 160 employees = 59.2 employees, which rounds to 59.

   Family coverage:

   48% x 160 employees = 76.8 employees, which rounds to 77.

MATHEMATICS ON THE JOB I
QUIZ 2

MATHEMATICS ON THE JOB I
QUIZ 2

I. Add or subtract the following decimal numbers. Round to 2 decimal places.

A. .768 + 13.42 + .0869 = **14.2749 = 14.27**

B. 3.15 + 125 + .5951 = **128.7451 = 128.75**

C. 10.19 - 6.4532 = **3.7368 = 3.74**

D. 16.07 - 8.1 = **7.97**

E. .750 + .00160 = **.7516 = .75**

II. Multiply or divide the following decimal numbers. Round to 3 decimal places.

A. 16.75 x 8.4 = **140.7 = 140.700**

B. 65 / 1.54 = **42.207792 = 42.208**

C. 59.78 / .443 = **230.220-75 = 230.221**

D. .7875 x 6.2 = **4.8825 = 4.883**

mat1q2a.cwp

MATHEMATICS ON THE JOB I
QUIZ 2

III. Solve the following word problems:

A. Alex Chakkas drove a company car on a recent business trip. He drove 35.9 miles Monday, 263.8 miles on Tuesday, 134 miles on Wednesday, 176.2 miles on Thursday, and only 25 miles on Friday. How many miles did he drive all together?

35.9 miles + 263.8 + 134 + 176.2 + 25 = 634.9 miles

B. José earns an hourly rate of $13.27. His time card shows the following work schedule for last month. How much were his wages for the month? (José is paid time and a half for any hours over 37.5 per week.)

Wk	Hrs. Worked	**Wages** (Overtime $13.27 x 1.5 = $19.91)		
1	42.75	**(37.5 x $13.27) + (5.25 x $19.91)**	**=**	**$602.15**
2	53.25	**(37.5 x $13.27) + (15.75 x $19.91)**	**=**	**$811.21**
3	38.25	**(37.5 x $13.27) + (0.75 x $19.91)**	**=**	**$512.56**
4	57.375	**(37.5 x $13.27) + (19.875 x $19.91)**	**=**	**$893.34**
				$2,819.26

MATHEMATICS ON THE JOB I
QUIZ 2

C. If the specification of a trim length is .625 plus or minus .030, what are the upper and lower control limits?

Upper limit: .625 + .030 = .0655

Lower limit: .625 - .030 = .595

D. If a towmotor can go for 375 miles between servicing, and it has been driven 139.6 miles already, how many miles are left before the servicing?

375 miles - 139.6 miles = 235.4 miles (can be rounded to 235)

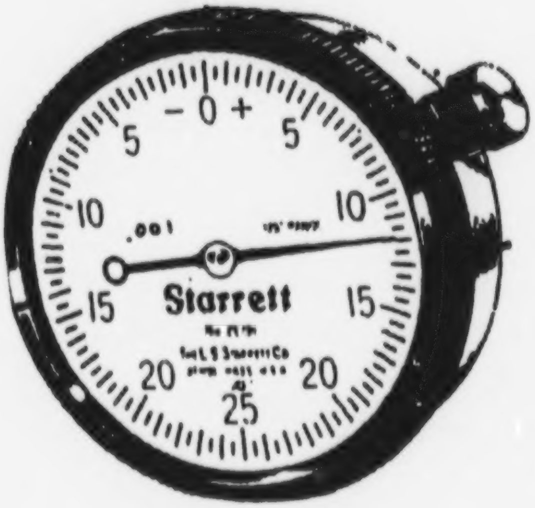
E. A salesman stopped to buy gas for his car. If the gas cost $1.09 per gallon, and he purchased 16.4 gallons of gas, how much did he spend?

$1.09 per gallon x 16.4 gallons = $17.88

MATHEMATICS ON THE JOB I
QUIZ 2

F. What do the needles show on the following gages? How is that read? (Give the fractional equivalent.)

12	- 3
12/1000	-3/10,000



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Starrett
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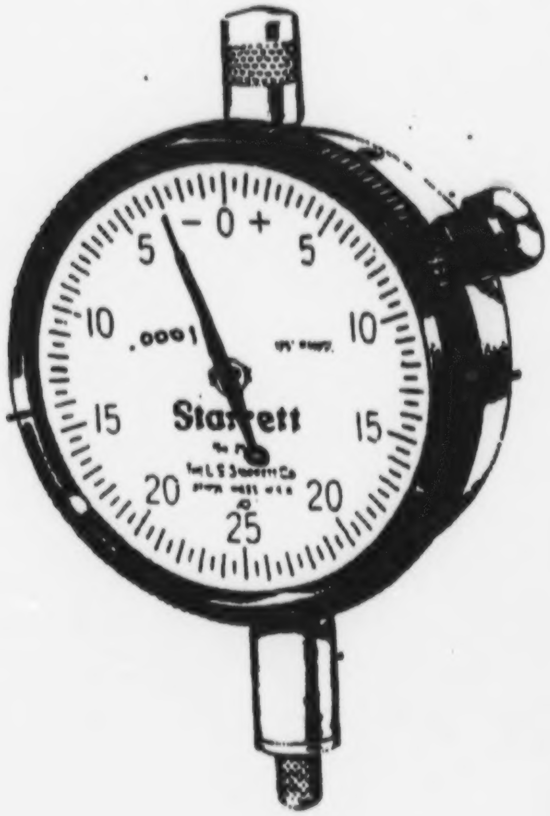

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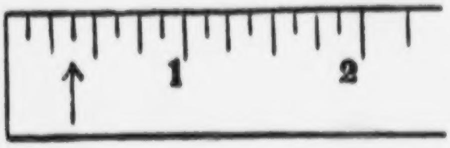
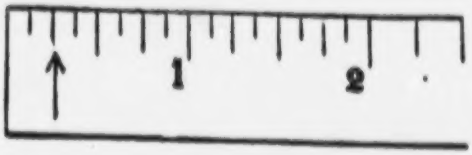
MATHEMATICS ON THE JOB I
QUIZ 2

G. Draw an arrow on each of the following rulers which represents the measurement given.

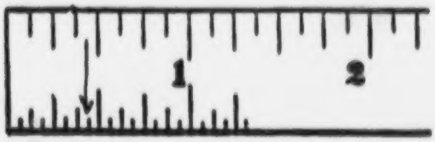
3/8"



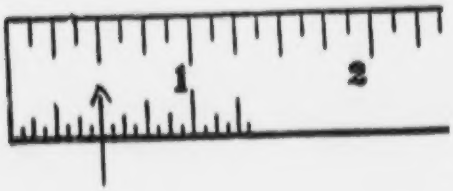
1/4"



7/16"



1/2"



OBJECTIVES

SESSION 9

- Demonstrate the ability to accurately fill out SPC charts used by CWP.
- Demonstrate the ability to use a calculator to solve decimal and percent word problems involving various operations.

MATHEMATICS ON THE JOB I
SESSION 9

Quality Control Reports

Introduction

This final chapter will require the application of the concepts you have learned so far to the workplace, and the specific reports workers at CWP are required to chart and fill out. Although actual forms have been used, the numbers on them may or may not be realistic; nevertheless, the forms will serve for practice, and discussion as to the purpose of Quality Control charting.

Quality Control charts, particularly when used in an automated environment, are not an attempt to track each worker's performance as much as a tracking of the performance of the various machines used in the workplace. Much like keeping track of your car's mileage on each tank of gas can alert you to problems which might require attention, so these charts can alert management to machines which might require servicing or adjustments.

Scrap/Rework Charts

The next two pages have scrap/rework charts. On each, do the following:

1. Determine how many pieces (total) need to be reworked/scrapped this week **for each reason**.
2. Determine the total pieces that need to be reworked/scrapped each day **for all reasons**.
3. Finally, determine the total pieces reworked/scrapped this week for all reasons.
4. If each piece scrapped/reworked costs CWP $4.00, what is **the total cost to the company for this week's scrap/rework?**

MATHEMATICS ON THE JOB I
SESSION 9

PART NUMBER: 661912-003 - RYOBI 12" BALL BEARING BRUSHROLL ASSY.
661912-004 - RYOBI 14" BALL BEARING BRUSHROLL ASSY.
661912-006 - RYOBI 14" BALL BEARING BRUSHROLL ASSY. (4 ROW)

REWORK AND SCRAP REPORT

SHIFT:

	MON	TUES	WED	THURS	FRI	SAT	TOTAL
LIST DATES HERE: REWORK:	3/6	3/7	3/8	3/9	3/10	3/11	
BERNELLED BEARING(S)	21	22	45	29	3	6	126
MISSING TUFT(S)	18	19	13	7	4	7	68
	39	41	58	36	7	TOTAL REWORK = 13	194
SCRAP:							
CRACKED WOOD AT BEARING ASSY.	185	101	86	31		45	448
HIT OFF(S)							
DEFECT IN WOOD							
NOT LOCKED IN (BRISTLER)	4	1	3	5	5	4	22
SET-UP SCRAP		2	7	3	1	5	18
TOO SHORT		1			1		2
NO PAINT ON ONE SIDE	1		1		2		4
						TOTAL SCRAP =	
INITIALS:							

190 105 97 39 9 54 494

(194 + 494) × $4.00 = $2,752

MATHEMATICS ON THE JOB I
SESSION 9

PART NUMBER: 303889 - KIRBY GEN. 3 RUG RENOVATOR BRUSH

REWORK AND SCRAP REPORT

SHIFT:

	MON	TUES	WED	THURS	FRI	SAT	TOTAL
LIST DATES HERE:	2/2	2/3	2/4	2/5	2/6	2/7	
REWORK:							
MISSING TUFT(S)	4	6	35	4			49
THIN TUFT(S)	15	20	22	25	31	10	123
HIT OFF(S)	7		4	1	6	12	30
	26	26	61	30	37	22 TOTAL REWORK =	202
SCRAP:							
HIT OFF(S)	4	4	9	8		1	26
DID NOT SHIFT PROPERLY	2		1		1	1	5
PATTERN OFF	3	3	2	4	3	2	17
SET-UP SCRAP	1	6	2	4		1	14
						TOTAL SCRAP =	62
INITIALS:							
	10	13	14	16	4	5	

Facilitator 9 - 3

(202 + 62) × \$4.00 = \$1,056

MATHEMATICS ON THE JOB I
SESSION 9

Gage Charts

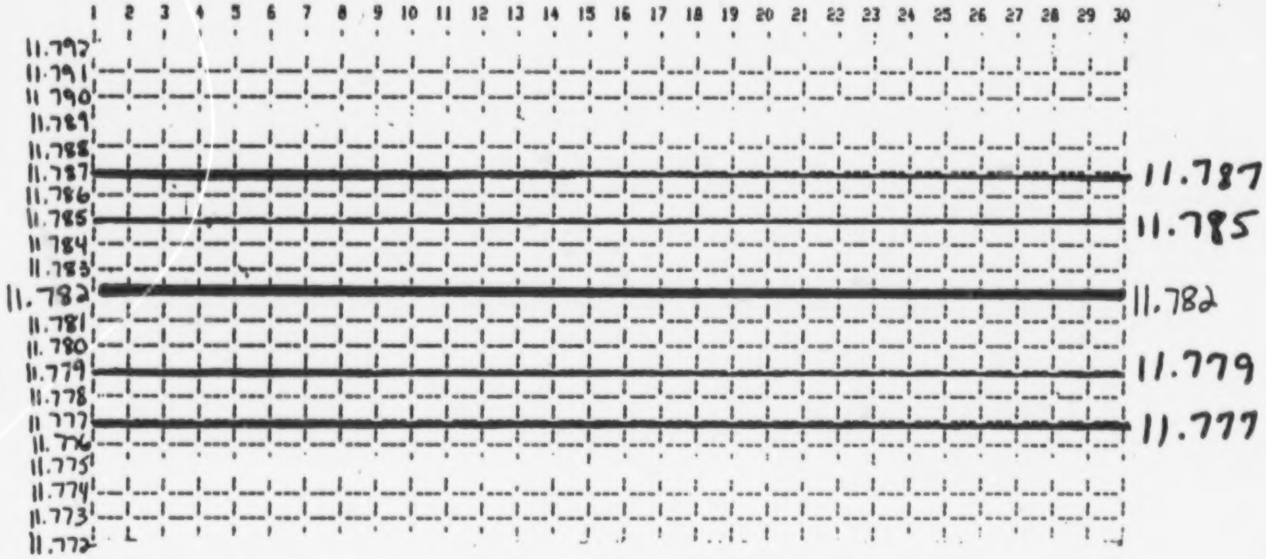
The next three pages have sample Gage Charts. On each chart, do the following:

1. Calculate the Specification upper and lower tolerance.
2. Calculate the Control Limits (both upper and lower).
3. Draw heavy lines on each chart at each of the four points you determined.

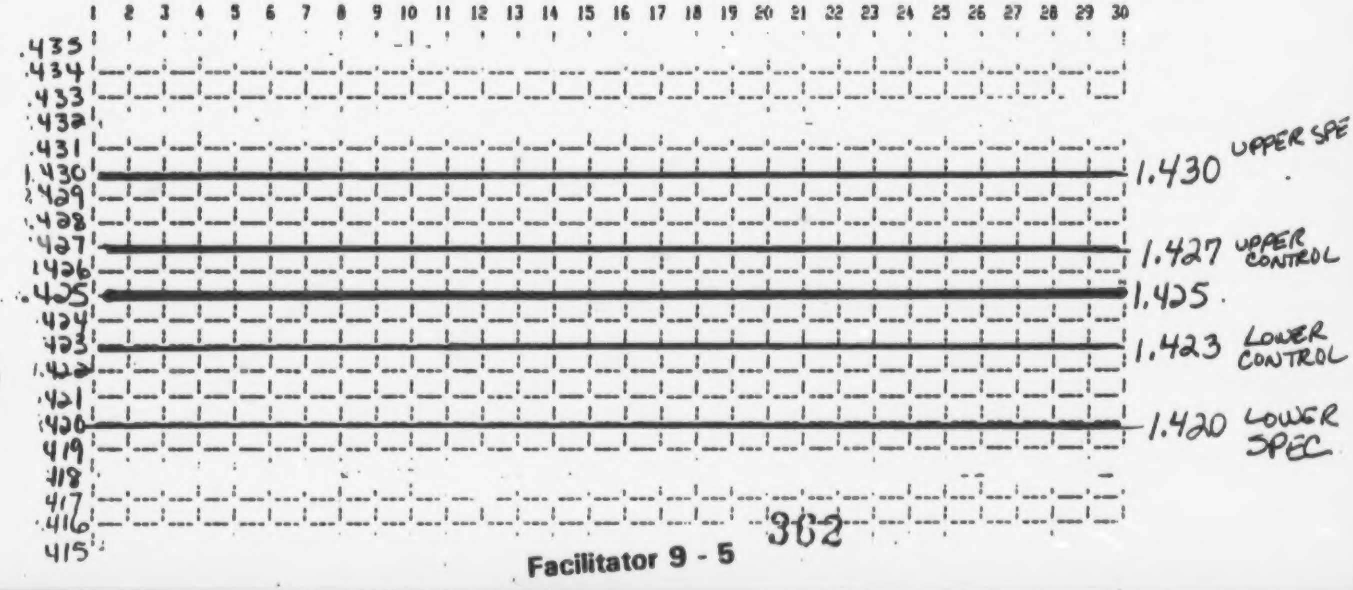
MATHEMATICS ON THE JOB I
SESSION 9

Part Number: D912	**Date:**	CLEVELAND WOOD PRODUCTS PRE CONTROL CHARTS
Part Name: 12" Ryobi. Wood Dowel	**Shift:**	
	Operator:	

Characteristic: Overall Length
Specification: 11.782 ± .005
Gage: Height Gage #5002
Operation: CB/Double Ender
Control Limits 11.782 ± .003
Frequency: 2 pcs. every 2 hours



Characteristic: Outside Diameter Pulley
Specification: 1.425 ± .005
Gage: 2" Bench Micrometer #2042
Operation: Locatelli
Control Limits 1.425 ± .002
Frequency: 2 pcs. every 2 hours



MATHEMATICS ON THE JOB I
SESSION 9

CMP SPC CHART

Part Number: 80172A

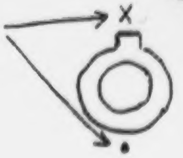
Part Name: Douglas Ring with Pin Brush

Date:

Shift:

Operator:

Measure in two places



Note: Verify presence of .500" off-center tuft.

Characteristic: Trim Length

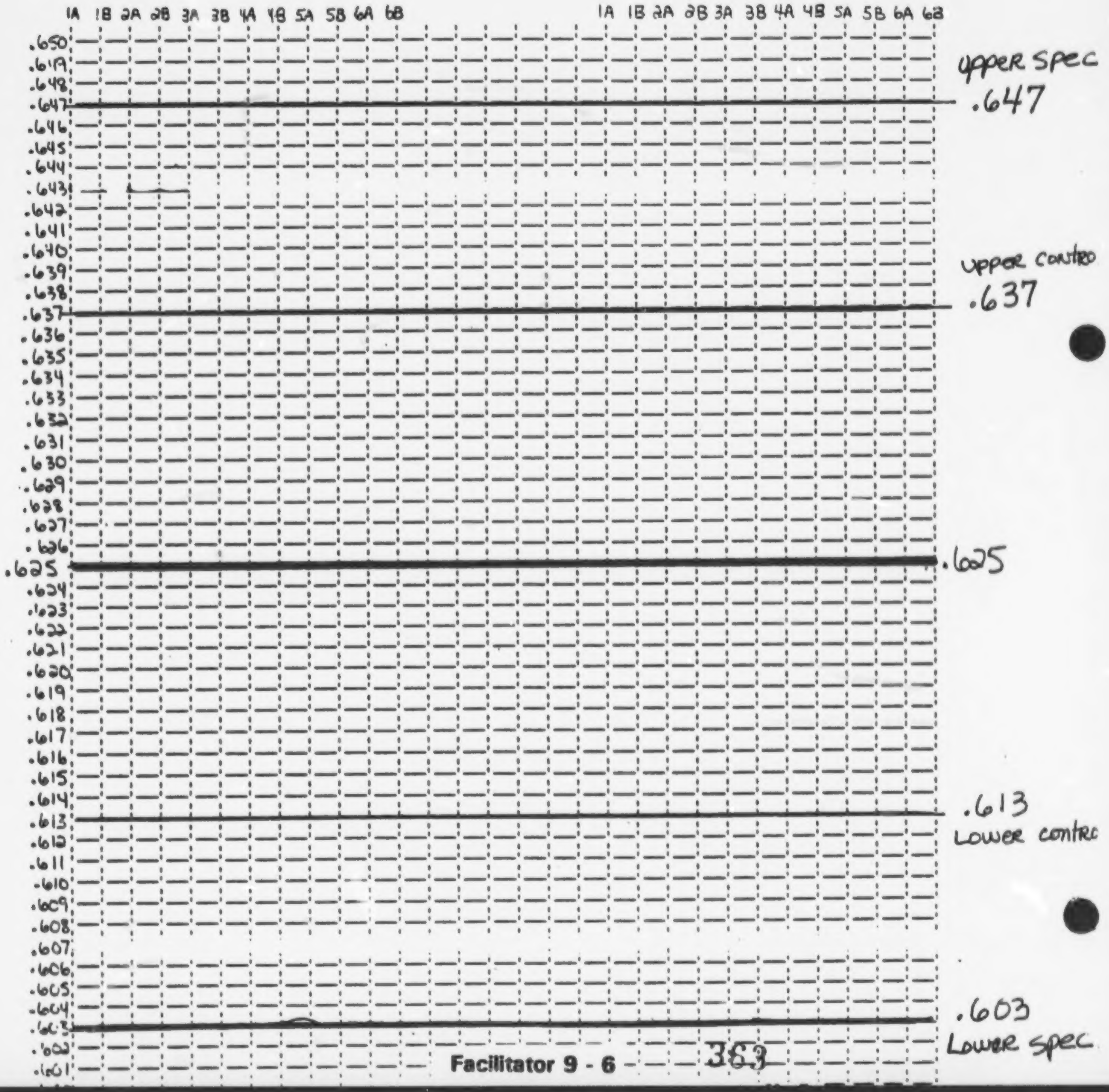
Specification: .625 ± .022

Gage: Caliper

Operation: Trimmer

Control Limits: .625 ± .012

Frequency: 2 pieces each shift from each holder



MATHEMATICS ON THE JOB I
SESSION 9

Circle **Part Number:** 7540-0086/7540-0089 **Date:**

CUP SPC CHART

Part Name: Regina Dirt Magnet/ Lux Lite Brushroll Assembly's **Shift:**

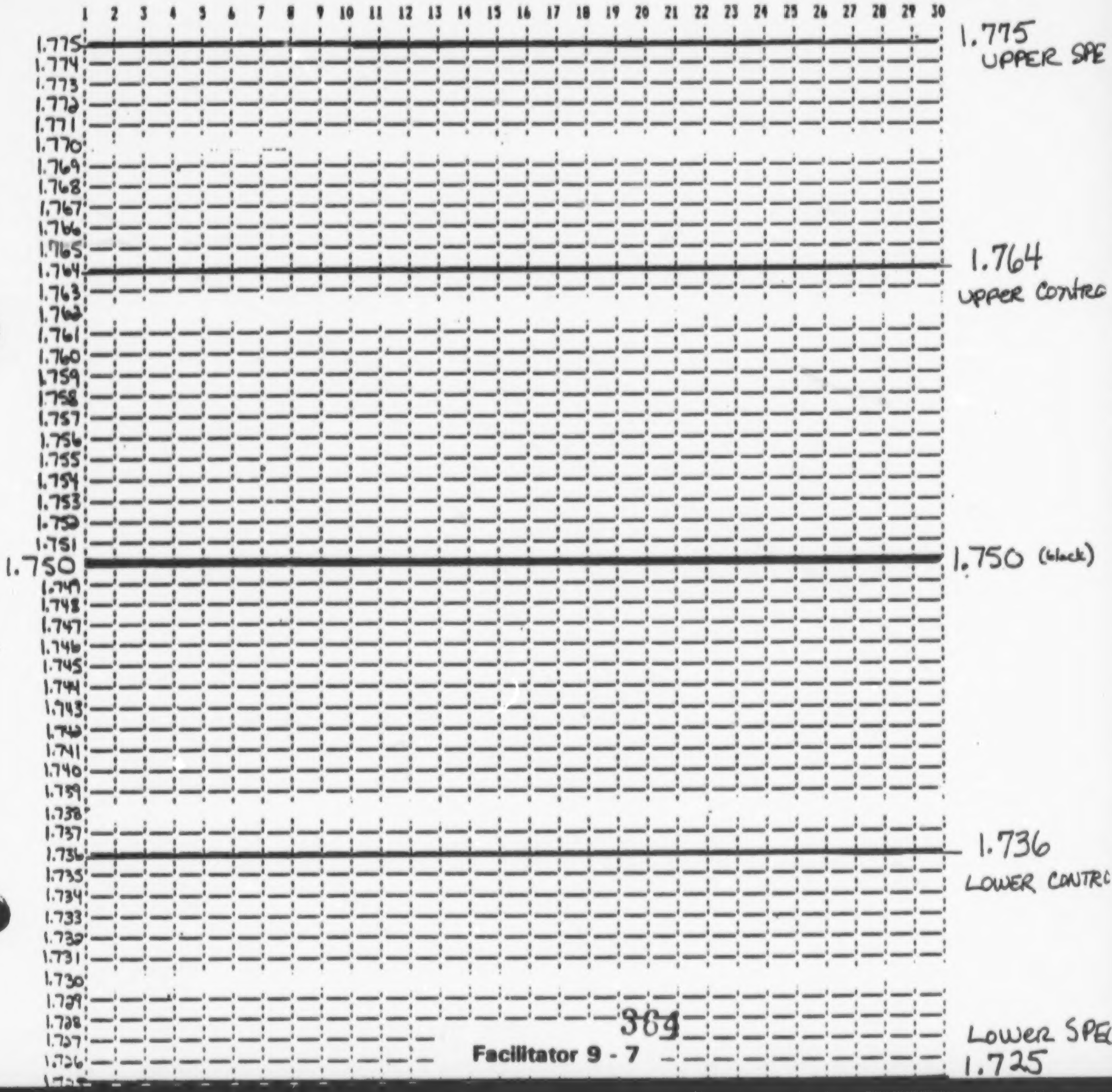
X - white cap end

● - black cap end

Operator:

Characteristic: Trim Diameter **Specification:** 1.750 ± .025 **Gage:** Caliper

Operation: Trimmer **Control Limits:** 1.750 ± .014 **Frequency:** 2 pcs. every 3 hours



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MATHEMATICS ON THE JOB I
SESSION 9

Production Sheets

Instructor Note: These sheets are quite complicated, and will be explained here in considerable detail. Please present the information orally and begin to work through the form together. Once you feel the participants understand the idea, allow them to finish the form alone or in small groups, either in class or for homework. **Be sure to correct the form after all participants have worked on it.**

On your answer key, each piece of information has been labelled with a letter. The letter is also included on the participants' copy of the form. Below is an explanation of each item:

Down the left-hand side of the top page are numbers from 1 to 31. These are for the dates of the month. The dates of the month also appear on page 2, in a narrow column immediately to the right of column G, Total Man Hours.

A - Number of Starting Cartons (CTNs)

This is the number of cartons the workers in the cell found when they came to work in the morning. Normally, it should equal the number of ending cartons they had last evening.

B - Skids Pulled

The number of skids removed from their cell's work area during the day.

C - Ending Cartons (CTNs)

The number of cartons the workers left in their cell's work area when they left work for the day.

D - Quantity/Carton (Qty/Ctn)

The number of pieces per carton. This will vary, depending on the product being packed. **In this example, there are 35 pieces per carton.**

E - Cartons/Skid (Ctn/Skid)

The number of cartons per skid. **In this example, there are 40 cartons per skid.**

F - Total Pieces Produced (Total Produced)

Participants must calculate this number. The formula is as follows:

[C - A + (B x E)] x D or,

Ending Cartons minus Starting Cartons plus Total Cartons Pulled today (that is, number of skids pulled x number of cartons per skid). This answer, the number of cartons produced, should be multiplied by the number of pieces per carton to get the number of pieces produced.

G - Total Man Hours

Participants must calculate this number. The formula is as follows:

(I x J) - H or,

Number of hours in the shift x number of people in the cell

H - Manhours Lost

Total number of manhours the cell lost this shift is given, along with a reason for the lost manhours. For example, if there are 4.5 people in the cell, and the machine was down for 1 hour, manhours lost was 4.5 people x 1 hour = 4.5 manhours.

I - Number of people in cell

The workers in a particular cell will know this number. **For this example, use 4.5.**

J - Shift

The number of hours in the shift.

The Graph: Pieces per Manhour (Pcs/Manhr.)

Participants must graph the number of pieces produced per manhour, and must calculate the number. The formula follows:

F / G or,

Total pieces produced divided by Total Manhours.

Note: There is no place to write the answer to the above formula; participants just need to indicate with a dot where on the chart it would fall.

After plotting all the points, the points should be connected with a solid line.

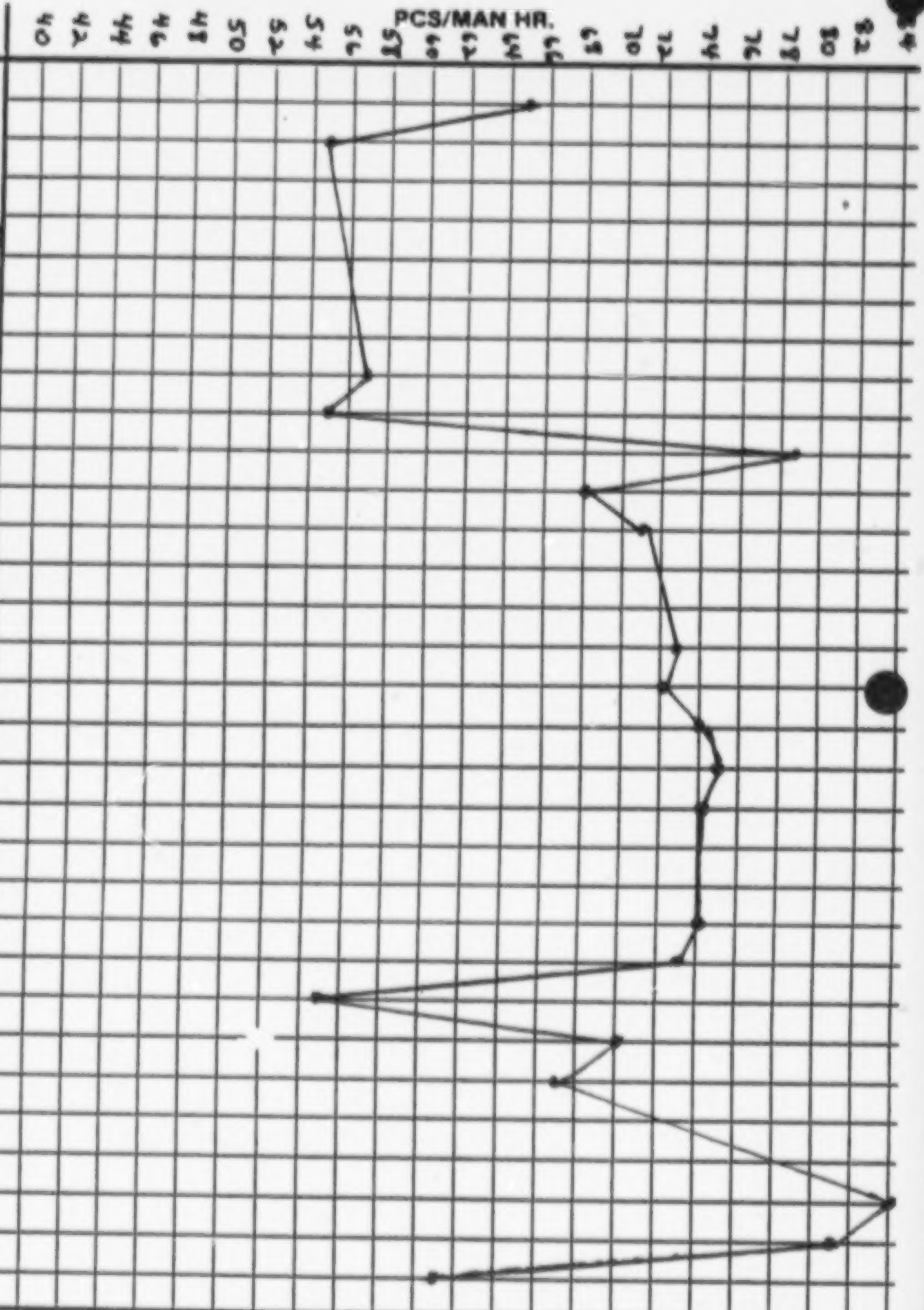
Instructor Note: Because of the complexity of the chart, it is highly recommended that you work through part of it yourself as you prepare for the class, and be prepared to explain the logic to the class. Participants may well have difficulty following the formula; sometimes it is easier to explain logic than a formula.

Ⓓ 35 PCS./CARTON Ⓔ 40 CTNS/SKID

DATE	STARTING CTN	SKIDS PULLED	ENDING CTN	MAN HRS. LOST GIVEN	REASON
1	Ⓐ 23	Ⓑ 2	Ⓒ 2	Ⓗ 4	NO SUB ASSY.
2	2	0	13	29	NO ROLLERS
3	13	0	13		NO ROLLERS
4	13	0	13		NO ROLLERS
5	13	0	30	10	BELT BROKEN; NO ROLLERS
6					WEEKEND
7					
8	30	2	2	4	HIT OFF
9	2	1	3	10	HIT OFF
10	31	1	18	24	WIRE HOLEY ROLLERS
11	18	1	36	6	WIRE HIT OFF
12	36	2	21	4	HOLEY ROLLERS
13					WEEKEND
14					
15	21	2	16	—	
16	16	2	2	4	HIT OFF WIRE
17	2	1	32	3	HIT OFF WIRE
18	32	2	29	—	
19	29	2	8	8	MACHINE BROKE
20					WEEKEND
21					
22	8	2	4	—	
23	4	1	37	1	HIT OFF
24	37	2	7	4	MISSING TUFTS
25	7	2	0	—	
26	0	1	10	10	SKID REJECT
27					WEEKEND
28					
29	10	2	2	6	HIT OFF
30	2	1	36	4	BELT BROKEN
31	36	2	14	3	HIT OFF WIRE

MATHEMATICS ON THE JOB I
SESSION 9

Ⓕ TOTAL PRODUCED	Ⓖ TOTAL MAN HRS.	DATE
2,065	32	1
385	7	2
0	0	3
0	0	4
595	26	(23) 5
/	/	6
/	/	7
1,820	32	8
1,435	26	9
945	12	10
2,030	30	11
2,275	32	12
/	/	13
/	/	14
2,625	36	15
2,310	32	16
2,450	33	17
2,695	36	18
2,065	28	19
/	/	20
/	/	21
2,660	36	22
2,555	35	23
1,750	32	24
2,555	36	25
1,750	26	26
/	/	27
/	/	28
2,520	30	29
2,590	32	30
2,030	33	31



NUMBER OF PEOPLE IN CELL - 4.5 Ⓘ

Part # ____________

Description ____________

Month ____________

Shift DAYS - 8 HRS. Ⓙ

Qty/Ctn 35 Ⓓ

Ctn/Skid 40 Ⓔ

MATHEMATICS ON THE JOB I
SESSION 9

Additional Word Problems

1. At a particular factory, there are 25 center boring machine operators, 10 quality control inspectors and 5 people in the Paint Shop. Another 25 are engaged in packing the product for shipment. There are 100 employees in total. What is the percentage of each type of worker?

Center boring machine operators	**25%**
Quality control inspectors	**10%**
Paint Shop employees	**5%**
Packing employees	**25%**

Remind participants that, since there are 100 employees in total, all they had to do was put a percent sign after the number of employees in each job classification. The problem will show whether they remember that a percent is always a fraction with a denominator of 100.

2. Ariel Secretarial Service bills its clients in tenths of an hour, at an hourly rate of $14.35. Because CWP had a critical administrative employee out on extended sick leave, it contracted with Ariel to provide certain secretarial services. On Monday, the service did 5.7 hours of work for CWP; on Tuesday, 6.2; on Wednesday, 1.4; on Thursday, 3.8; and on Friday, 8.3. How much did Ariel bill CWP?

5.7 + 6.2 + 1.4 + 3.8 + 8.3 = 25.4 hours

$14.35 x 25.4 hours = $364.49

3. In the Ohio Tufts Company factory, each run of tufts is checked manually for acceptable quality, before being shipped out. The first week of this month, the reject rate on a run of 35,487 sets of tufts was .012. How many sets of tufts were rejected?

   35,487 sets of tufts x .012 = 425.844 sets. This can be rounded to 426.

4. In one shipment, 1.68% of the 27,800 crates were damaged. How many crates were damaged? If the insurance will pay $4,362.25 for each damaged crate, how much should the company bill the insurance company?

   1.68% x 27,800 crates = 467.04 crates (Should be rounded to 467.)

   467 crates x $4,362.25 = $2,037,170.80

   Check that participants placed the commas correctly. This is a bigger number than they are used to working with normally.

5. This month's sales goal for Easy Writer Pen Company is 2,380,000 ball-point pens. If the company has reached 77.5% of its goal, how many pens have been sold so far?

   77.5% x 2,380,000 pens = 1,844,500 pens

6. Marcos just got his paycheck. His gross pay was $1,235.79, and he had the following deductions: health insurance $125.26; United Way $10; dental insurance $32.40; savings bonds $20; federal tax $185.39; state tax $123.58; social security tax $92.68. How much was Marcos' take-home pay?

   $1,235.79 gross pay - $125.26 - $10.00 - $32.40 - $20.00 - $185.39 - $123.58 - $92.68 = $646.48

7. Total daily circulation of the *Herald* is 180,000. If complimentary (non-paid) circulation is 5,400 copies a day, and the daily price of the newspaper is $ .35, how much money is the *Herald* earning each day? What is the value of the papers it gives away for promotional purposes?

   180,000 total - 5,400 free = 174,600 paid papers

   174,600 paid papers x $.35 each = $61,110.00 earned each day

   If 5,400 are given away at a cost of $ .35 each, then they lost $1,890.00 each day. (5,400 x $ .35)

MATHEMATICS ON THE JOB I
POST-ASSESSMENT

I. Write the following as whole numbers:

A. Four hundred thousand nine hundred eighty-six

____

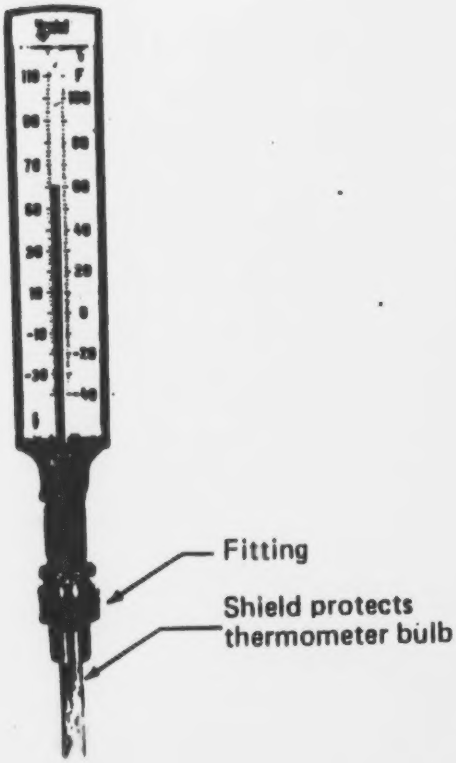
B. Seven million eight hundred twenty-one thousand one hundred thirty-three

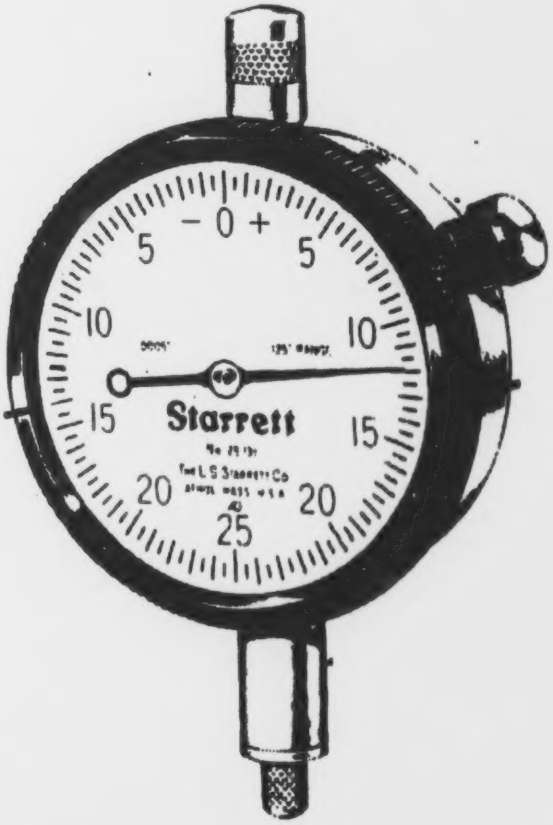
____

II. A. The mercury on this thermometer reads at _______ degrees F.

B. The dial on this indicator points to the number _________.

This is read as _______________.


Fitting
Shield protects thermometer bulb


− 0 +
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15
15
20
20
25
Starrett

III. Add the following numbers:

A.
$$\begin{array}{r} 415 \\ +\ 932 \\ \hline \end{array}$$

B.
$$\begin{array}{r} 18,441 \\ 59,609 \\ +\ 23,484 \\ \hline \end{array}$$

IV. Subtract the following numbers:

A.
$$\begin{array}{r} 495 \\ -\ 23 \\ \hline \end{array}$$

B.
$$\begin{array}{r} 88 \\ -\ 74 \\ \hline \end{array}$$

V. Solve the following problems:

A. An automatic machine requires servicing after every 300 hours of operation. If the operating-time indicator now reads 193 hours, how many hours remain before the next service is required?

B. Add the Pieces Scrapped due to cracked wood at the bearing assembly.

____

SCRAP:

CRACKED WOOD AT BEARING ASSY.	185	101	86	31		45	
HIT OFF(S)							
DEFECT IN WOOD							
NOT LOCKED IN (BRISTLER)	4	1	3	5	5	4	
SET-UP SCRAP		2	7	3	1	5	
TOO SHORT		1			1		
NO PAINT ON ONE SIDE	1		1		2		
INITIALS:						TOTAL SCRAP =	

VI. Multiply the following numbers:

A.
$$\begin{array}{r} 812 \\ \times 716 \\ \hline \end{array}$$

B.
$$\begin{array}{r} 8,421 \\ \times 18 \\ \hline \end{array}$$

VII. Divide the following, and indicate the remainder, if any.

A. $184 \div 23 =$

B. $64 \overline{)9245}$

VIII. Solve the following problems:

A. Yesterday, 347 boxes of 32 brush assemblies each were packed in your department. How many brush assemblies total were packed?

B. Find the average number of pieces reworked due to Bernelled Bearings.

____

PART NUMBER: 661912-003 - RYOBI 12" BALL BEARING BRUSHROLL ASSY.
661912-004 - RYOBI 14" BALL BEARING BRUSHROLL ASSY.
661912-006 - RYOBI 14" BALL BEARING BRUSHROLL ASSY. (4 ROW)

REWORK AND SCRAP REPORT

SHIFT:

	MON	TUES	WED	THURS	FRI	SAT	TOTAL
REWORK: LIST DATES HERE:	3/6/93	3/7/93	3/8/93	3/9/93	3/10/93	3/11/93	
BERNELLED BEARING(S)	21	22	45	29	3	6	
MISSING TUFT(S)	18	19	13	7	4	7	

TOTAL REWORK =

IX. Convert the following:

A. Write the fraction equivalent of .500. ____________________

B. What is the decimal equivalent of 1/4? ____________________

X. Add the following decimal numbers:

A. .836 + 1.59 + 42.64 =

B. 49.23 + .80 + 7.41 =

XII. Subtract the following decimal numbers:

A. 18.449 - .671 =

B. 8.224 - .55 =

XIII. Solve the following problems using the Rework and Scrap Report given below for 12" Ball Bearing Brushroll Assemblies:

SCRAP:

CRACKED WOOD AT BEARING ASSY.	185	101	86	31		45	
HIT OFF(S)							
DEFECT IN WOOD							
NOT LOCKED IN (BRISTLER)	4	1	3	5	5	4	
SET-UP SCRAP		2	7	3	1	5	
TOO SHORT		1			1		
NO PAINT ON ONE SIDE	1		1		2		
INITIALS:						TOTAL SCRAP =	

A. How many brushroll assemblies were scrapped during the week because they were not locked in? ____________

B. If each piece of scrap costs Cleveland Wood Products $4.00, what is the expense for all brushroll assemblies scrapped (for any reason) during this week? ____________

XIV. Multiply the following decimal numbers:

A. 8.83 x 92.4 =

B. .855 x 1.5 =

XV. Divide the following decimal numbers. Carry your answers out to 3 decimal places.

A. 82.4 ÷ .58 =

B. 77.51 ÷ 8.9 =

XVI. Solve the following problems:

A. You worked 187.5 hours in 2.5 weeks. How many hours did you average per week? _______________

B. You can earn 2 vacation days each month. How many days of vacation would you have at the end of 6.5 months? ___________________

XVII. Solve the following word problems.

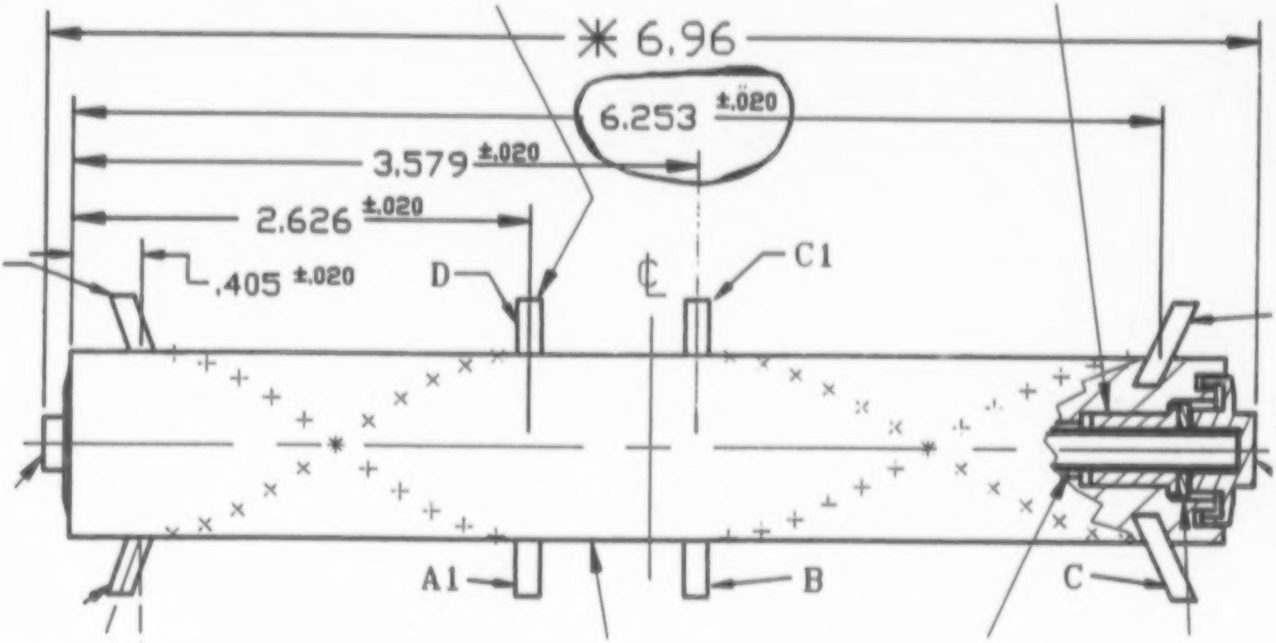
A. Currently, Tina paints 475 dowels a day. She needs to increase her production by 7%. How many dowels will she need to paint each day?

B. Anna works overtime every week; she is paid time and a half for any hours over 40 each week. Her hourly wage is $12.50. In February of this year, Anna worked 55 hours the first week, 63 hours the second week, 42 hours the third week and 60 hours the last week. How much did Anna earn (before taxes or other deductions were taken out of her check)?

C. You accrue sick time at the rate of .5 days per every 2 months worked. At the end of one year, how much sick time have you accrued?

D. Find the upper (+) tolerance on the circled length.

____



✱ 6.96
6.253 ±.020
3.579 ±.020
2.626 ±.020
.405 ±.020
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℄
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B
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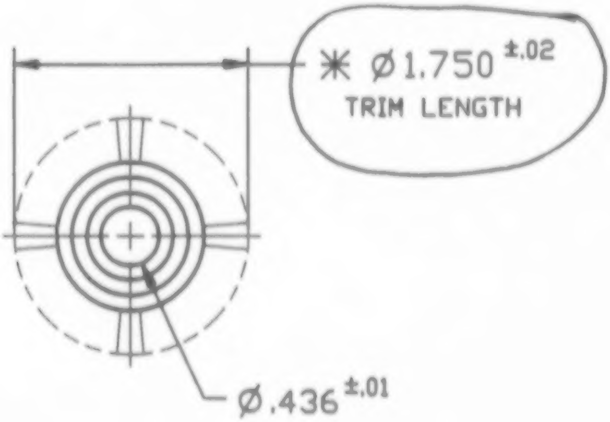
E. What is the lower (-) tolerance for the circled dimension?

____



✱ Ø1.750 ±.02
TRIM LENGTH
Ø.436 ±.01

MATHEMATICS ON THE JOB I
QUIZ 1

Write the following as whole numbers:

1. Four hundred thousand nine hundred eighty-six

____

2. Seven million eight hundred twenty-one thousand one hundred thirty-three

____

3. Two thousand nine hundred fifty-four

____

4. Nine hundred seventy-six billion eight hundred fifty-six million ninety-one thousand forty-four

____

Put commas in the following numbers:

5. 7 6 4 9 0 8 3

6. 1 0 4 3

7. 5 6 7 3 4 0

MATHEMATICS ON THE JOB I
QUIZ 1

Add the following numbers:

8.
4
7
+ 5

9.
67
88
+ 43

10.
1,276
+ 7,893

11.
873
+ 452

12. List all the ways you can think of to change the order of the numbers below according to the commutative property.

6 + 10 + 4

MATHEMATICS ON THE JOB I
QUIZ 1

13. Are the following mathematical statements true or false?

a.) $1 + 3 + 5 = 5 + 3 + 1$

b.) $10 + 17 + 91 = 91 + 17$

14. List 3 different ways to group the numbers below according to the associative property.

$2 + 4 + 8 + 16 + 20$

15. Are the following mathematical statements true or false?

a.) $(9 + 1) + (7 + 10) = 9 + (1 + 7) + 10$

b.) $17 + 89 + (35 + 76 + 90) = (17 + 89) + 35 + 76 + 90$

Subtract the following numbers:

16. $\begin{array}{r} 78 \\ -\ 42 \\ \hline \end{array}$

17. $\begin{array}{r} 919 \\ -\ 765 \\ \hline \end{array}$

18. $\begin{array}{r} 16{,}786 \\ -5{,}927 \\ \hline \end{array}$

MATHEMATICS ON THE JOB I
QUIZ 2

I. Add or subtract the following decimal numbers. Round to 2 decimal places.

A. .768 + 13.42 + .0869 =

B. 3.15 + 125 + .5951 =

C. 10.19 - 6.4532 =

D. 16.07 - 8.1 =

E. .750 + .00160 =

II. Multiply or divide the following decimal numbers. Round to 3 decimal places.

A. 16.75 x 8.4 =

B. 65 / 1.54 =

C. 59.78 / .443 =

D. .7875 x 6.2 =

mat1q2.cwp

MATHEMATICS ON THE JOB I
QUIZ 2

III. Solve the following word problems:

A. Alex Chakkas drove a company car on a recent business trip. He drove 35.9 miles Monday, 263.8 miles on Tuesday, 134 miles on Wednesday, 176.2 miles on Thursday, and only 25 miles on Friday. How many miles did he drive all together?

B. José earns an hourly rate of $13.27. His time card shows the following work schedule for last month. How much were his wages for the month? (José is paid time and a half for any hours over 37.5 per week.)

Wk	Hrs. Worked
1	42.75
2	53.25
3	38.25
4	57.375

MATHEMATICS ON THE JOB I
QUIZ 2

C. If the specification of a trim length is .625 plus or minus .030, what are the upper and lower control limits?

D. If a towmotor can go for 375 miles between servicing, and it has been driven 139.6 miles already, how many miles are left before the servicing?

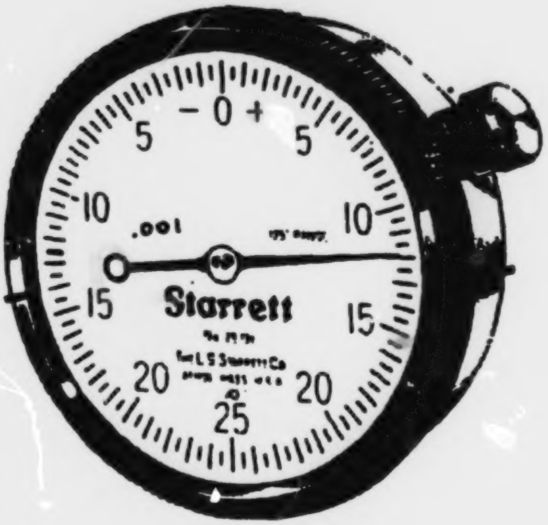
E. A salesman stopped to buy gas for his car. If the gas cost $1.09 per gallon, and he purchased 16.4 gallons of gas, how much did he spend?

MATHEMATICS ON THE JOB I
QUIZ 2

F. What do the needles show on the following gages? How is that read? (Give the fractional equivalent.)

______________________ ______________________

______________________ ______________________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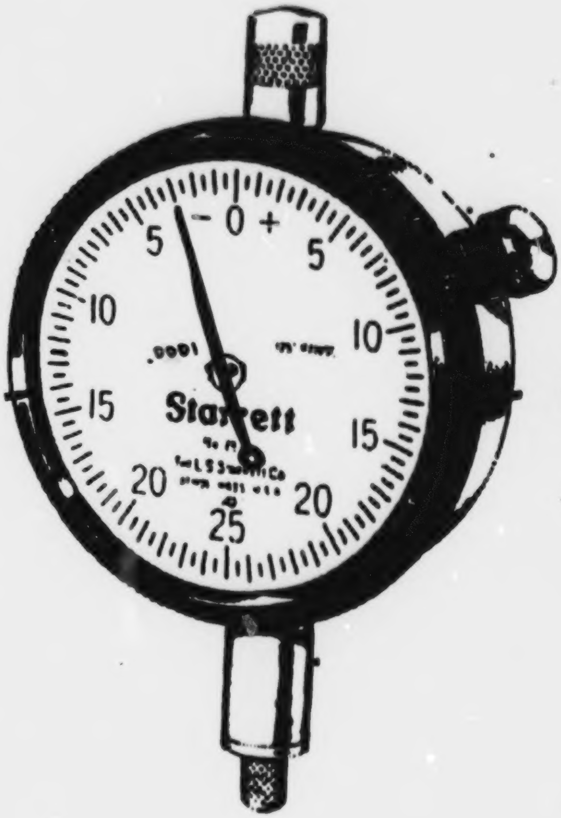
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Starrett
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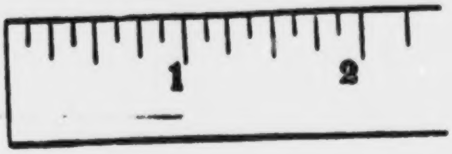
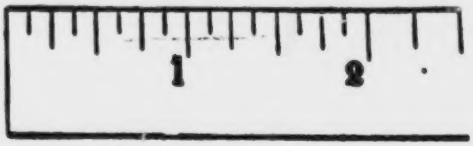
MATHEMATICS ON THE JOB I
QUIZ 2

G. Draw an arrow on each of the following rulers which represents the measurement given.

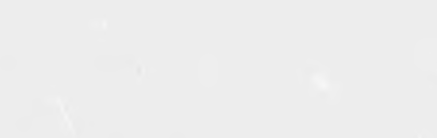
3/8"



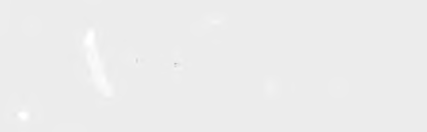
1/4"



7/16"



1/2"



CWP
a Scott Fetzer company

Mathematics

on-the-job

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II

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CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
PRE-ASSESSMENT

I. Add or subtract the following fractions. Reduce your answer to lowest terms. If the answer is an improper fraction, convert it to a mixed number.

A. 3/4 + 5/8 =

B. 1 7/8 – 49/64 =

II. Multiply or divide the following fractions. Reduce your answer to lowest terms. If the answer is an improper fraction, convert it to a mixed number.

A. 8/9 x 21/64 =

B. 5/8 ÷ 10/13 =

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
PRE-ASSESSMENT

III. Insert either < or > in the space between each pair of numbers to make the statement correct.

A.	3 −4	B.	−6 −8
C.	5 6	D.	7 −7

IV. A. What is | 54 |? ______________________

B. What is | −16 |? ______________________

V. Add or subtract the following integers:

A. $-5 + 3 =$

B. $8 - (-6) =$

C. $9 + (-3) =$

VI. Multiply or divide the following integers:

A. $(-7)\ (10) =$

B. $(-4) \div (-2) =$

C. $(-2)\ (-3) =$

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
PRE-ASSESSMENT

VII. Evaluate the following expressions:

A. $2 + [3 - (6 \times 2) + 12] =$

B. $2((3 + 4) \cdot 2) + 2 - 10 =$

C. $((2 + 6 \cdot 8 - 3) - 10) + 5 =$

D. $8 \cdot 2 + 7 + 9 / 3 - 3 \cdot 3 =$

VIII. Total each day's gauge readings on the following table and place the answer in the row marked "ΣX".

Day:	Mon	Tue	Wed	Thu	Fri
Reading 1	+.05	−.02	+.32	+.33	+.11
Reading 2	−.11	+.31	+.12	+.15	−.21
Reading 3	−.30	+.05	+.03	−.21	−.02
Reading 4	+.23	−.22	−.15	−.30	−.14
ΣX =					

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
PRE-ASSESSMENT

IX. Solve the following percentage-related problems:

A. Production of brushes is averaging 1 defective brush out of every 270 made. What is the percentage of defective brushes out of the total produced?

B. A 12-inch brush must be within 99% of its proper length to pass inspection. How short can a brush be and still pass inspection?

C. Out of 50 rejected brushes, 7 were rejected because they were not properly locked in the bristler, 35 because they were caught in the trimmer, and 8 because the brushroll was smashed putting in bearings. What percentage were rejected because they got caught in the trimmer?

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
PRE-ASSESSMENT

X. Solve the following ratio-related problems.

A. A machine normally can core 120 brushes in 2 hours. How many brushes can it produce in 3 hours?

B. A machine normally can drill 100 brushes in 1 hour. If the speed is increased by 50%, how many brushes can the machine process in 4 hours?

C. If seven workers can produce 322 brushes per hour, how many brushes could two workers produce an hour?

D. If Max can finish 344 brushes in a shift, how many brushes could he finish in half a week?

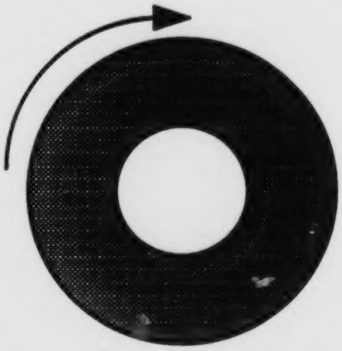
CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
PRE-ASSESSMENT

XI. Solve the following problems.

For questions A and B, use the following formula:

Wheel Surface Speed =

Diameter of Wheel x 3.14 x
Revolutions per Minute ÷ 12



A. If the diameter of the wheel is 10 inches and the RPM is 100 revolutions per minute, what is the wheel surface speed?

B. If the diameter of the wheel is 20 inches and the RPM is 160 revolutions per minute, what is the wheel surface speed?

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
PRE-ASSESSMENT

For questions C and D, use the following formulas:

Pieces per Shift = (Skids Pulled x Cartons per Skid x Pieces Per Carton) –
(Starting Cartons x Pieces Per Carton) +
(Ending Cartons x Pieces Per Carton)

Total Man Hours = Man Hours – Lost Man Hours

Pieces per Man Hour = Pieces Per Shift / Total Man Hours

C. If, during their shift, Roger's team pulled 5 skids, had 3 starting cartons and 2 ending cartons, and there were 54 pieces a carton, how many pieces did they produce during their shift?

D. Using the answer from question C, if Roger's team worked 48 man hours, but lost 8 man hours due to an equipment failure, how many pieces did they produce per man hour?

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II

OBJECTIVES

SESSION 1

✔ State an increased comfort with math and express increased self-confidence with math skills.

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MATHEMATICS ON THE JOB II
SESSION 1

GOALS FOR MATHEMATICS ON THE JOB II

The Mathematics on the Job II course will provide you with:

- ✓ An opportunity for you to learn/review math skills necessary to effectively perform your job.

- ✓ An increased understanding of how important math is to your job, and to our technological society.

- ✓ The training and practice necessary to help you feel more comfortable with math and to increase your self-confidence with your math skills.

MATHEMATICS ON THE JOB II
SESSION 1

PERSONAL MATH GOALS

It's important to know what your personal goals for math are. Take a few minutes and write down a math goal that you would like to accomplish in this Mathematics on the Job II class.

MY PERSONAL MATH GOAL IS:

MATHEMATICS ON THE JOB II
SESSION 1

SOME REASONS FOR MATH ANXIETY

✔ **Past Conditioning** - we were told that we weren't good at math or we were "tracked" in high school and assumed we didn't need or couldn't learn math.

✔ **Can't see the need for math** - Often when we're younger, we don't realize or fail to see the importance of math to our future or our daily work lives. Now that we have jobs that require us to use math, it becomes much more relevant.

✔ **We believe myths about math**

1. Math is hard and complicated to learn

   Math is different from learning vocabulary or how to read a blueprint. But math isn't as mysterious or complicated as we may have been led to believe. Everyone in this room has the ability to learn math.

2. Math is for eggheads.

   Everyone needs and can learn math. And you don't necessarily have to have a "mathematical mind" to understand math. Sure, the eggheads may need and use theory more, but math skills and reasoning are useful and learnable by people at many different levels.

✔ **Not enough experience using math**

Maybe until now or recently, you never had much need for math. So, you probably don't have a lot of math experience. This class, will, of course, provide experience. And as you practice math skills, you'll feel more comfortable with your math abilities.

Other reasons for math anxiety:

MATHEMATICS ON THE JOB II
SESSION 1

WHAT YOU CAN DO TO GET AND KEEP A POSITIVE ATTITUDE

✓ **Believe in yourself.**

✓ **Tell yourself you know you can do it!**

You can use affirmations/positive statements to help you in this area. Come up with a positive statement about your ability to learn math. Repeat this to yourself several times daily. Also, whenever negative thinking creeps in, stop, and replace those negative thoughts with your new positive statement.

✓ **Stay relaxed.**

If you find yourself getting frustrated, take a break, mental or physical, for a few minutes. Then approach the problem or concept again.

✓ **Get rid of "all-or-nothing," have-to-be-perfect attitudes.**

Yes, the right answer is important in math, but you're learning. So, give yourself credit for what you do right!

WAYS I PLAN TO WORK ON A POSITIVE ATTITUDE:

MATHEMATICS ON THE JOB II
SESSION 1

POSITIVE MATH STATEMENT

In order to replace outdated, negative attitudes with new, positive attitudes, we need to have a positive statement about our math abilities, to repeat to ourselves several times daily and to use when negative thinking creeps in.

Take a few minutes now to write a 1-sentence positive statement about your ability to learn and/or use math. Memorize or refer to this statement often, so you can repeat it to yourself whenever you need or want to. Some people like to put these statements on index cards for easy reference.

MY POSITIVE MATH STATEMENT:

Using this technique will help you gain self-confidence and bring you closer to achieving math success.

MATHEMATICS ON THE JOB II
SESSION 1

WHAT TO EXPECT

✔ **Math is a process.**

✔ **Math is learned by doing, not just observing.**

In this class, there will be lots of opportunities to practice working problems. If you need more practice, there are software programs available in the learning lab and extra problem sets can be obtained from the instructor.

✔ **Everyone learns math at different rates and approaches problems a little differently.**

MATHEMATICS ON THE JOB II
SESSION 1

WHAT'S EXPECTED

To succeed in math, you'll need to do the following:

- ✓ **Attend classes.**

  Missing a class automatically puts you behind since math builds on skills. If you have to miss a class, contact the instructor. She or he can fill you in on what you'll be missing, and direct you to appropriate exercises and software to help you catch up quickly.

- ✓ **Participate in class.**

  Ask questions when you're lost.

  Actively participate in class and team activities.

  Complete in-class assignments.

- ✓ **Listen actively and take effective notes.**

  Try to follow what the instructor's saying even if you can't make sense of it all, right away. (And don't be shy about asking questions.)

  Take neat, meaningful notes. This will help you to make sense of what was discussed later on.

- ✓ **Practice, practice, practice.**

  As mentioned earlier, this is the best way to learn math.

MATHEMATICS ON THE JOB II
SESSION 1

MATH NOTETAKING AND STUDY TIPS

Notetaking Tips

Tip # 1: Be neat.

In math, neatness counts!! You need to be able to follow the problem-solving process, both in your notes and when working problems.

Tip # 2: Write down the problem as the instructor works it out on the board and write down your explanation of the steps in the process.

This will help you to understand the process and your notes will be a lot more useful because they won't just be a bunch of numbers.

Tip # 3: Copy down all definitions and principles.

It's important that you know and understand these. They'll be used over and over again in class and for explanations.

Tips for Reviewing Your Notes

Tip # 4: Rework the example problems.

Before you go on to the uncharted territory of practice problems, be sure you can work the known territory of the example problems in your notes. If you get stuck on the example problem, you can ask the instructor for clarification. This will save you time and frustration when you're out there on your own with the practice problems.

MATH NOTETAKING AND STUDY TIPS

Study Tips

Tip # 5: Make sure you can explain the process for working different types of problems.

Explain it out loud, to yourself, to someone else, to your cat

and/or

Write down a process to follow when working out problems of a certain type. Pretend you're explaining it to someone who doesn't know it.

Tip # 6: Work all practice problems as completely as you can.

Don't stop if you get a wrong answer to one of them and aren't sure where you went wrong, or if you notice the problems are getting more difficult. If you've gone over a problem several times and can't pinpoint your error, mark it and go on to the next one. Then come back to it. Or make a note to ask the instructor about it in the next class. When receiving an explanation, make sure you understand what the error was so you can avoid it in the future.

MATHEMATICS ON THE JOB II
SESSION 1

MATH NOTETAKING AND STUDY TIPS

Notetaking Example

Adding a Positive and a Negative Number

Problem	Process
	1. Find the difference between the # with the larger absolute value and the # with the smaller absolute value. 2. Put the sign of the # with the larger absolute value in front of the answer.

MATHEMATICS ON THE JOB II
SESSION 1

A PROCEDURE TO SOLVE MATH PROBLEMS

Below is a general procedure to follow when solving math problems.

1. **Don't be afraid of the problem** (especially if it looks complicated). Go ahead, give it your best shot. Even if you don't get the right answer, you'll learn a lot about the math process.

2. **Examine or read the problem carefully.** Determine what you're given and what you're supposed to find.

3. **Refer to your process for solving the type of problem you're working on.** Follow the process, step by step. Be sure to be neat.

4. **Recheck your work.** (Neatness makes this easier.) Many students skip this step, but those that recheck learn more (they see where they make their mistakes) and gain confidence more quickly (they take the opportunity to learn from and correct their mistakes.)

5. **Ask yourself is the answer is reasonable.** Does it make sense, given the information you had to work with? Or does is seem way off? If it doesn't seem right, go back to Step 4, one more time.

Remember: You have the ability to learn and solve math problems. If you use the tips and techniques given in this module, you'll be on your way to math success.

OBJECTIVES

SESSION 2

- ✓ Demonstrate ability to work with fractions.
- ✓ Demonstrate ability to solve word problems involving fractions.

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MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Definitions

Denominator

Fraction

Greatest Common Factor

Least Common Denominator

Numerator

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Reducing Fractions to Lowest Terms

When you're working with fractions, you'll find it easier to solve problems if you convert the fractions to lowest terms. This way you'll avoid working with numbers that are large or cumbersome.

Reducing a fraction to lowest terms means that there is no number other than 1 that will divide evenly into both the numerator and the denominator.

Follow these steps to reduce a fraction to lowest terms:

1. Determine the largest number which will divide evenly into both the numerator and the denominator. This is called the Greatest Common Factor.

2. Divide both the numerator and the denominator by the greatest common factor.

Example:

18/66

1. 6 is the GCF (Greatest Common Factor) of 18 and 66

2. $\frac{18}{66} \div \frac{6}{6} = \frac{3}{11}$

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Finding the Greatest Common Factor

Sometimes, finding the greatest common factor of 2 numbers is not so easy. So, here's a method that will help you to always find the greatest common factor:

1. Write the numerator and the denominator as the product of primes. A prime number is one which can only be divided by itself and 1.
2. Make a list of the primes common to both the numerator and the denominator.
3. Multiply the primes you listed in Step 2 together to figure out the greatest common factor.

Examples:

Find the greatest common factor of the numerator and the denominator in the fraction 125/600.

1. 125 = 5 x 5 x 5

   600 = 2 x 2 x 2 x 3 x 5 x 5

2. Two 5's are present in both numbers.

3. 5 x 5 = 25

   25 is the GCF of 125 and 600.

FRACTIONS REVIEW

Finding the Greatest Common Factor (cont'd)

Find the greatest common factor of the numerator and the denominator in the fraction 420/1320

1. 420 = 2 x 2 x 3 x 5 x 7

   1320 = 2 x 2 x 2 x 3 x 5 x 11

2. Two 2's, one 3 and one 5 are present in both numbers.

3. 2 x 2 x 3 x 5 = 60

   60 is the GCF of 420 and 1320

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Adding and Subtracting Fractions with Like Denominators

To add or subtract fractions with like denominators:

1. Add or subtract the numerators.
2. Put the sum or difference over the common denominator.
3. If necessary, reduce the answer to lowest terms.

Examples:

$\frac{7}{10} - \frac{3}{10} = \frac{4}{10}$ Reduce: $\frac{4 \div 2}{10 \div 2} = \frac{2}{5}$

$\frac{5}{12} + \frac{4}{12} = \frac{9}{12}$ Reduce: $\frac{9 \div 3}{12 \div 3} = \frac{3}{4}$

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Adding and Subtracting Fractions with Unlike Denominators

Before we can add or subtract fractions that have unlike denominators, we must first convert them to fractions with the same denominator. The easiest way to keep the numbers from getting complicated is to use the lowest common denominator, or the smallest number that's divisible by each of the 2 denominators.

To find the LCD (Lowest Common Denominator):

1. Write each denominator as the product of primes.

2. Determine the maximum amount of times each prime appears in each denominator.

3. Multiply the primes together, only the maximum amount of times each appears in either of the 2 denominators. In other words, do not repeat multiplication of a prime the maximum number of times, if it appears in both denominators.

Example: Find the lowest common denominator for 5/16 and 9/60.

1. 16 = 2 x 2 x 2 x 2
   60 = 2 x 2 x 3 x 5

2. 2 appears 4 times.
   3 appears 1 time.
   5 appears 1 time.

3. Multiply 2 x 2 x 2 x 2 x 3 x 5 together.

   2 x 2 x 2 x 2 x 3 x 5 = 240
   240 is the LCD of 16 and 60

NOTE: The two 2's appearing in the product of primes of 60 are not repeated for the multiplication in Step 3.

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Adding and Subtracting Fractions with Unlike Denominators

Finding the Lowest Common Denominator

Examples:

Find the lowest common denominator for the fractions, 6/49 and 120/126.

1. 49 = 7 x 7

   126 = 2 x 3 x 3 x 7

2. 2 appears 1 time.
   3 appears 2 times.
   7 appears 2 times.

3. Multiply 2 x 3 x 3 x 7 x 7 together.

   2 x 3 x 3 x 7 x 7 = 882

   882 is the LCD of 49 and 126

NOTE: The one 7 appearing in the product of primes of 126 is not repeated for the multiplication in Step 3.

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Adding and Subtracting Fractions with Unlike Denominators (cont'd)

Once you've found the lowest common denominator for 2 fractions, it's a lot easier to add or subtract them. To add or subtract fractions with unlike denominators:

1. Find the lowest common denominator.
2. Convert each fraction to an equivalent fraction with the lowest common denominator found in Step 1. After you convert, each fraction should have the same denominator.
3. Add or subtract the numerators.
4. Put the sum or difference over the lowest common denominator.
5. If necessary, reduce the fraction to lowest terms.

Examples: 5/16 + 9/60

1. We've already determined the LCD is 240.
2. 5/16 needs to be converted to an equivalent fraction whose denominator is 240.

   Since 240 ÷ 16 is 15, you'll need to multiply both the numerator and the denominator by 15.

$$\frac{5}{16} \begin{matrix} \times \\ \times \end{matrix} \frac{15}{15} \begin{matrix} = \\ = \end{matrix} \frac{75}{240}$$

   9/60 needs to be converted to an equivalent fraction whose denominator is 240.

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Adding and Subtracting Fractions with Unlike Denominators

Examples (cont'd):

Since 240 ÷ 60 is 4, you'll need to multiply both the numerator and denominator by 4.

$$\frac{9}{60} \times \frac{4}{4} = \frac{36}{240}$$

3 & 4.

$$\frac{75}{240} + \frac{36}{240} = \frac{111}{240}$$

5. 111/240 can be reduced to 37/80. In lowest terms: 111/240 = 37/80
Review steps to reduce 111/240 to lowest terms.

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Adding and Subtracting Fractions with Unlike Denominators

Examples (cont'd):

6/49 + 120/126

1. We've already determined the LCD is 882.

2. 6/49 needs to be converted to an equivalent fraction whose denominator is 882

   Since 882 ÷ 49 is 18, you'll need to multiply both the numerator and the denominator by 18.

$$\frac{6}{49} \times \frac{18}{18} = \frac{108}{882}$$

   120/126 needs to be converted to an equivalent fraction whose denominator is 882.

   Since 882 ÷ 126 is 7, you'll need to multiply both the numerator and denominator by 7.

$$\frac{120}{126} \times \frac{7}{7} = \frac{840}{882}$$

3 & 4. 108/882 + 840/882 = 948/882

5. 948/882 = 158/147 or 1 11/147

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Practice

Add or subtract the following fractions. Be sure to reduce the answers to lowest terms.

5/16 - 3/16 =

9/10 + 3/12 =

65/72 - 3/8 =

8/9 + 7/21 + 6/81 =

1/8 + 5/8 =

9/32 - 1/16 =

5/32 + 7/60 =

3/16 + 7/16 =

19/80 + 3/50 =

56/90 - 5/8 =

FRACTIONS REVIEW

Multiplying Fractions

To multiply fractions together:

1. Multiply the numerators.
2. Multiply the denominators.
3. Put the product of the numerators over the product of the denominators.
4. If necessary, reduce the answer to lowest terms.

HINT: In multiplication, you can cancel out common factors in the numerators and denominators before you multiply. This will often help you avoid having to reduce the answer to lowest terms, or get your answer a lot closer to being in lowest terms.

Examples:

5/6 x 7/8 = 35/48

35/48 is in lowest terms.

3/16 x 4/9

In this problem, we can cancel as follows:

3/16 x 4/9 = 1/12

FRACTIONS REVIEW

Dividing Fractions

To divide fractions:

1. Invert the divisor (typically, the number after the ÷ sign) and replace the division sign with a multiplication sign.

2. Multiply the numerators.

3. Multiply the denominators.

4. Put the product of the numerators over the product of the denominators.

5. If necessary, reduce the answer to lowest terms.

   HINT: In multiplication, you can cancel out common factors in the numerators and denominators before you multiply. This will often help you avoid having to reduce the answer to lowest terms, or get your answer a lot closer to being in lowest terms.

Examples:

$$\frac{6}{7} \div \frac{4}{5} = \frac{6}{7} \times \frac{5}{4} = \frac{30}{28}$$

$$\frac{30}{28} \begin{matrix}\div \\ \div\end{matrix} \frac{2}{2} \begin{matrix}= \\ =\end{matrix} \frac{15}{14}$$

(or 1 1/14)

$$\frac{3}{16} \div \frac{4}{9} = \frac{3}{16} \times \frac{9}{4} = \frac{27}{64}$$

27/64 is in lowest terms.

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Converting Improper Fractions to Mixed Numbers

Usually you'll be asked to convert improper fractions (those where the numerator is greater than the denominator) to mixed numbers. Follow these steps:

1. Divide the numerator by the denominator to determine the whole number portion of the mixed number.
2. Put the numerator over the denominator to express the fraction portion of the mixed number.
3. If necessary, reduce the fraction part to lowest terms.
4. Write the mixed number as the whole number and reduced fraction.

Examples: Convert 11/9 to a mixed number.

1. $$\begin{array}{r} 1 \\ 9\overline{)11} \\ \underline{9} \\ 2 \end{array}$$ 1 is the whole number position.
2. $\frac{2}{9}$ is the fraction portion.
3. $\frac{2}{9}$ cannot be reduced.
4. $\frac{11}{9} = 1\frac{2}{9}$

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Converting Improper Fractions to Mixed Numbers

Examples (Cont'd):

Convert 420/16 to a mixed number.

1. $$\begin{array}{r} 26 \\ 16\,\overline{)\,420} \\ \underline{32} \\ 100 \\ \underline{96} \\ 4 \end{array}$$ 26 is the whole number portion.

2. $\frac{4}{16}$ is the fraction portion.

3. $$\frac{4}{16} \begin{array}{c}\div\\ \div\end{array} \frac{4}{4} \begin{array}{c}=\\ =\end{array} \frac{1}{4}$$

4. $$\frac{420}{16} = 26\,\frac{1}{4}$$

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Converting Mixed Numbers to Improper Fractions

Often, when you are adding, subtracting, multiplying or dividing fractions, you'll need to convert mixed numbers to improper fractions. Here's how:

1. Multiply the denominator of the fraction times the whole number.
2. Add the product of the denominator and the whole number to the numerator.
3. Put the sum found in Step 2 over the denominator. This is the improper fraction. The numerator should be larger than the denominator.

Examples:

Express 1 2/15 as an improper fraction.

1. 1 2/15 15 x 1 = 15
2. 15 + 2 = 17
3. 17/15 is the improper fraction.

Express 16 2/3 as an improper fraction.

1. 16 2/3 3 x 16 = 48
2. 48 + 2 = 50
3. 50/3 is the improper fraction.

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Practice

Multiply the following fractions (Be sure to reduce your answer to lowest terms):

9/10 x 1/2 =	7/8 x 4/5 =
3/8 x 4 1/9 =	1 1/7 x 4/5 x 2 1/2 =

Divide the following fractions (Be sure to reduce your answer to lowest terms):

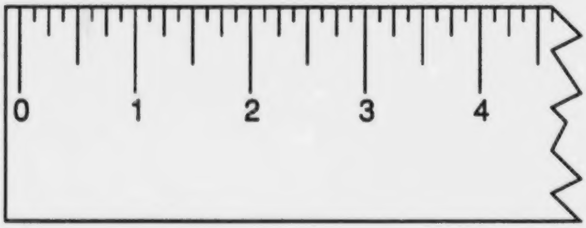
7/16 ÷ 3/4 =	6/33 ÷ 4/11 =
1/6 ÷ 8 2/9 =	5/7 ÷ 49/60 =

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Reading Rulers

Rulers are measuring tools that divide large units into fractional parts. Look at the ruler below. Notice that there are numbered sections on the ruler below, representing inches. Each of those inches is further divided into halves (the next tallest lines), then quarters (the next tallest), and finally eights of an inch. If an object you were measuring had one end on the '0' inch mark, and the other end fell halfway between the one and two inch marks, it would be 1 1/2 inches long.



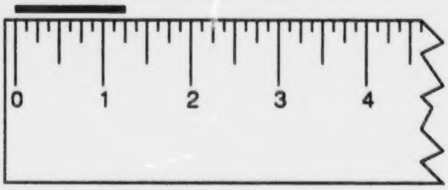
Most rulers divide the inches with lines of different lengths—each of the different line lengths represents a different fractional unit, such as quarter inches or eights of an inch. On the ruler above, the longest lines represent inches, the next tallest show half inches, the next tallest quarter inches, and the smallest are eighths of an inch. Some rulers divide inches even further, into sixteenths (1/16) and even thirty-seconds (1/32) of an inch.

Adding different measurements uses the same rules as for adding fractions. To add 7/8 inches and 1 3/4 inches, for example, you would use the same process used to add two fractions.

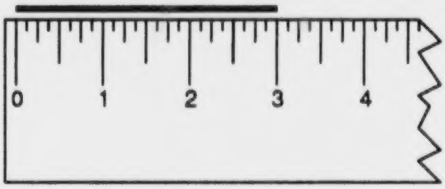
MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

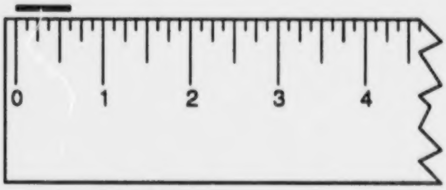
Exercise: What is the length of the line shown above each ruler?



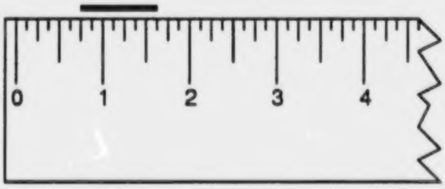
Answer:__________



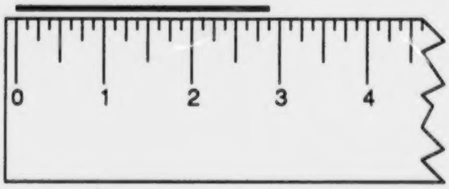
Answer:__________



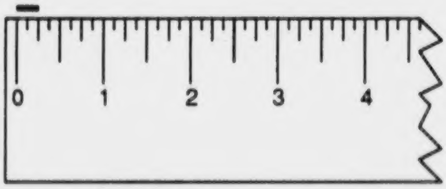
Answer:__________



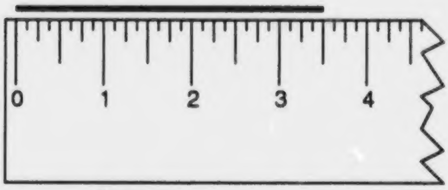
Answer:__________



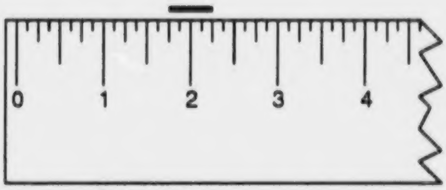
Answer:__________



Answer:__________



Answer:__________



Answer:__________

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II

OBJECTIVES

SESSION 3

✔ Demonstrate ability to work with decimals.

✔ Demonstrate ability to solve word problems involving decimals.

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MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Definitions

Decimal

____

____

____

Decimal Point

____

____

____

Rounding

____

____

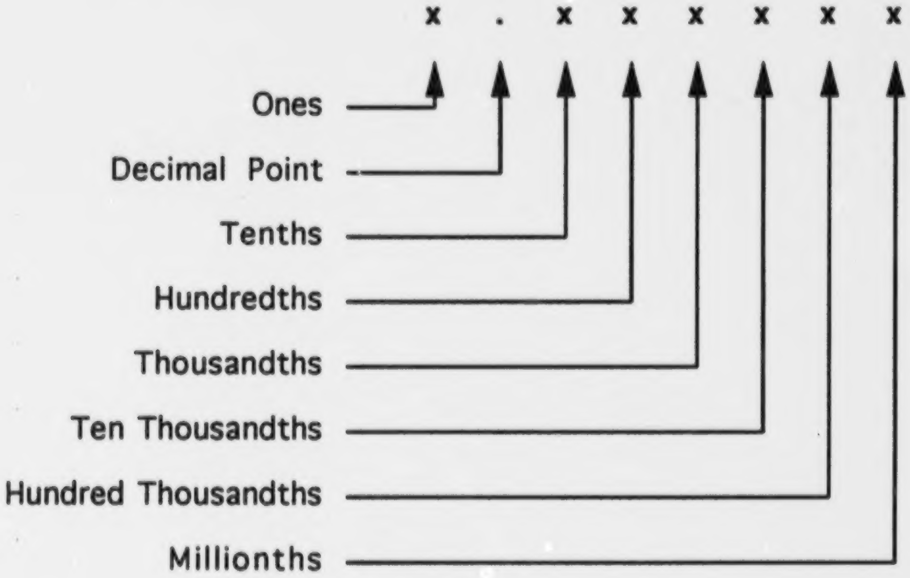
____

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Decimals Definition

A decimal is a fraction that has a denominator that is a multiple of 10. However, in writing decimals, the denominator is indicated by place value. The place values of numerals to the left of the decimal point are shown below:


x . x x x x x x
Ones
Decimal Point
Tenths
Hundredths
Thousandths
Ten Thousandths
Hundred Thousandths
Millionths

Exercise: What are the values of the following decimals?

.4 ____________________

.04 ____________________

.004 ____________________

.004 ____________________

.0004 ____________________

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Adding and Subtracting Decimals

Examples

$$\begin{array}{r} 4.27 \\ .0812 \\ 33.69 \\ +\ 5.1 \\ \hline 43.1412 \end{array}$$

$$\begin{array}{r} 48.734 \\ -\ 5.960 \\ \hline 42.774 \end{array}$$

$$\begin{array}{r} 7.18 \\ -\ 4.235 \\ \hline 2.945 \end{array}$$

Process

1. Arrange numbers in columns so that the decimal points line up.
2. Add or subtract the numbers as if the decimal points were not there.

   Hint: If there are blanks to the right of some numbers, treat the blanks as zeros. It may even help you to put zeros in place of the blanks, especially in subtraction.
3. Bring down the decimal point in the correct column.

Notes:

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Rounding Decimals in Addition and Subtraction Problems

If you need to round off an addition or subtraction answer, round it off to the same number of decimal places as the number in the problem with the least number of decimal places.

To figure out which way to round the digit:

If the numbers being dropped are:	Then:
1. Less than 5000	1. Keep the digit the same.
2. 5000 or greater	2. Increase the digit by 1.

Examples

$$\begin{array}{r} 4.17 \\ .0812 \\ 33.69 \\ +\,5.1 \\ \hline 43.0412 \end{array}$$

Rounds to 43.0 (one decimal place because the number with the least number of decimal places is 5.1, with only one decimal place.)

$$\begin{array}{r} 48.734 \\ -\,5.96 \\ \hline 42.774 \end{array}$$

Rounds to 42.77 (two decimal places because 5.96 has only two decimal places.)

$$\begin{array}{r} 7.18 \\ -\,4.235 \\ \hline 2.945 \end{array}$$

Rounds to 2.95 (two decimal places because 7.18 only has two decimal places.)

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Exercise: Solve the following problems.

1. 1.375 + .08 + 36.15 = __________

2. 42.1438 + 129.653 + 56.781 = __________

3. .4912 + .017 + .53 = __________

4. 2.798 + 35.2 + 4.674 = __________

5. 56.872 – 14.02 = __________

6. 425.68 – 45.926 = __________

7. .37915 – .0150 = __________

8. 2.78315 – .6543 = __________

9. 3.4589 + 5.382 = __________
   (Round your answer)

10. 37.5299 + 28.75 = __________
    (Round your answer)

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Multiplying Decimals

Example

$$\begin{array}{r} 2.65 \\ \times\ 3.3 \\ \hline 795 \\ 795 \\ \hline 8.745 \end{array}$$

$$\begin{array}{r} .014 \\ \times\ .51 \\ \hline 014 \\ 070 \\ \hline .00714 \end{array}$$

Process

1. Multiply the numbers first as if there were no decimal points.
2. Count the number of decimal places in the top number.
3. Count the number of decimal places in the bottom number.
4. Add the number of decimal places in the two numbers together.
5. Starting from the right, count over the same number of digits as the total number of decimal places in the numbers in the problem. Place your decimal point to the left of the digit.

Note: If there are not enough digits, you'll need to add 0's to the left of the number.

Notes:

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Rounding Decimals in Multiplication Problems

If you need to round off a multiplication answer, round it off to the same number of digits as the number in the problem with the least number of digits. Your answer must have no more digits than the number in the problem with the fewest digits. This is different than rounding off after adding or subtracting.

To figure out which way to round the digit:

If the numbers being dropped are:	Then:
1. Less than 5000	1. Keep the digit the same.
2. 5000 or greater	2. Increase the digit by 1.

Examples

2.65	(three digits)
x 3.3	(two digits)
795	
795	
8.745	**Rounds to 8.7** (two digits because the number in the problem with the least number of digits is 3.3, with two digits.)
.014	(two digits)
x .51	(two digits)
014	
070	
.00714	**Rounds to .0071*** (two digits because the number in the problem with the least number of digits is .51, which has two digits.)

*Zeros don't get counted!

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Dividing Decimals

Examples

$$\begin{array}{rr} & 9.7 \\ 2.14 & \overline{)\,20.758} \\ & \underline{-\,19\,26} \\ & 1\,498 \\ & \underline{-\,1\,498} \\ & 0 \end{array}$$

$$\begin{array}{rl} & 2.037 \\ 4.22 & \overline{)\,8.60000} \\ & \underline{-\,8\,44} \\ & 160 \\ & \underline{-\,0} \\ & 1600 \\ & \underline{-\,1266} \\ & 3340 \\ & \underline{-\,2954} \\ & 386 \end{array}$$

Process

1. Eliminate the decimal point in the divisor by moving it the required number of places to make it a whole number.

2. Move the decimal point in the dividend the same number of decimal places as you did for the divisor. (You're not trying to make this a whole number.)

   Note: If there are not enough places, you may need to add digits to the right of the dividend.

3. Divide as you would if there were no decimal points. Be sure to keep your numbers lined up.

4. Place the decimal point in the quotient directly above the moved decimal point in the dividend. This should be easy if your digits are lined up.

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Rounding Decimals in Division Problems

Rounding off a division answer works the same way as rounding off a multiplication answer. Round the number off to the same number of digits as the number in the problem with the least number of digits. Your answer should have no more digits than the number in the problem with the fewest digits.

To figure out which way to round the digit:

If the numbers being dropped are:	Then:
1. Less than 5000	1. Keep the digit the same.
2. 5000 or greater	2. Increase the digit by 1.

Examples

$$\begin{array}{r} 9.7 \\ 2.14\,\overline{)\,20.758} \\ -\,19\ 26 \\ \hline 1\ 498 \\ -\,1\ 498 \\ \hline 0 \end{array}$$

Rounds to 9.70 (three digits because the number in the problem with the fewest number of digits is 2.14, with three digits.)

$$\begin{array}{r} 2.037 \\ 4.22\,\overline{)\,8.60000} \\ -\,8\ 44 \\ \hline 160 \\ -\,0 \\ \hline 1600 \\ -\,1266 \\ \hline 3340 \\ -\,2954 \\ \hline 386 \end{array}$$

Rounds to 2.0 (two digits because the number in the problem with the fewest number of digits is 8.60000*, which only has two digits.

* Zeros don't get counted!

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Multiplying and Dividing Decimals

Practice

1. .375 x 2.9 = __________

2. 22.450 x .56 = __________

3. 77.35 x 2.5 = __________

4. .4187 x .358 = __________

5. 36 ÷ .47 = __________

6. 6.2812 ÷ 2.3 = __________

7. 127.91 ÷ 3.36 = __________

8. 4.9 ÷ .715 = __________

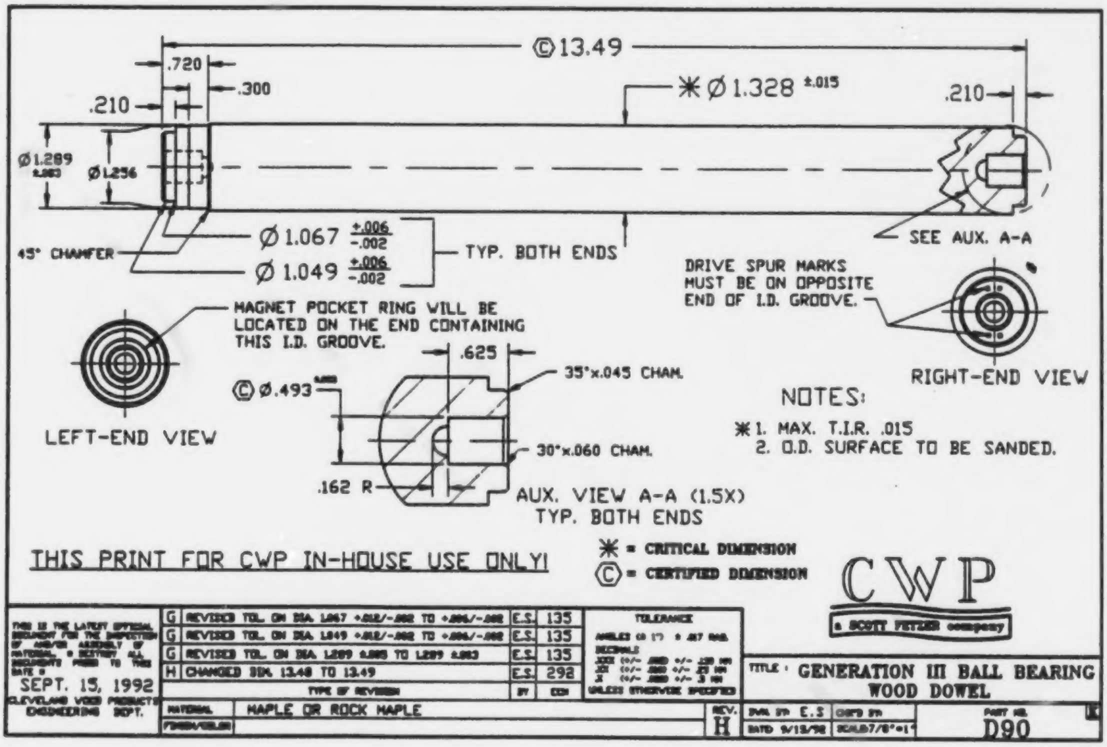
MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Solving Word Problems Involving Decimals

Sample Word Problem

Using the blueprint below, George must find the maximum and minimum acceptable diameter measurements for a Generation III ball bearing wood dowel. Looking at the blueprint, he sees that the desired diameter is 1.328 inches, plus or minus (±) .015 inches. Using this information, what are the maximum and minimum diameters which are still acceptable for this model of wood dowel?



Ⓒ13.49
.720
.300
.210
✱Ø 1.328 ±.015
.210
Ø1.289
Ø1.256
Ø 1.067 +.006 -.002
Ø 1.049 +.006 -.002
45° CHAMFER
TYP. BOTH ENDS
SEE AUX. A-A
DRIVE SPUR MARKS MUST BE ON OPPOSITE END OF I.D. GROOVE.
MAGNET POCKET RING WILL BE LOCATED ON THE END CONTAINING THIS I.D. GROOVE.
.625
35°x.045 CHAM.
Ⓒ Ø.493
30°x.060 CHAM.
.162 R
LEFT-END VIEW
RIGHT-END VIEW
AUX. VIEW A-A (1.5X) TYP. BOTH ENDS
NOTES:
✱1. MAX. T.I.R. .015
2. O.D. SURFACE TO BE SANDED.
THIS PRINT FOR CWP IN-HOUSE USE ONLY!
✱ = CRITICAL DIMENSION
Ⓒ = CERTIFIED DIMENSION
CWP
a SCOTT FETZER company
G REVISED TOL. ON DIA. 1.067 +.012/-.002 TO +.006/-.002 E.S. 135
G REVISED TOL. ON DIA. 1.049 +.012/-.002 TO +.006/-.002 E.S. 135
G REVISED TOL. ON DIA. 1.289 ±.005 TO 1.289 ±.003 E.S. 135
H CHANGED DIM. 13.48 TO 13.49 E.S. 292
TYPE OF REVISION
TOLERANCE
SEPT. 15, 1992
CLEVELAND WOOD PRODUCTS ENGINEERING DEPT.
MATERIAL MAPLE OR ROCK MAPLE
REV. H
TITLE: GENERATION III BALL BEARING WOOD DOWEL
E.S
PART NO. D90

REVIEW OF DECIMALS

Sample Word Problem (Cont'd.)

Step 1: **Determine what the question is**. What is the answer you are being asked to find?

What are the maximum and minimum diameters which are still acceptable for this model of wood dowel?

Step 2: **Identify the information you need to solve the problem**. Draw a sketch if possible to help visualize the problem.

The blueprint indicates that the desired diameter is 01.328 inches.
It also indicates that the tolerance for the diameter is ±.015 inches.

Step 3: **Identify what mathematical operation or operations to use**. Write down the problem you will need to solve.

To find the maximum and minimum acceptable diameters, we need to both add and subtract .015 to 1.328 inches. The addition of the tolerance will give us the maximum acceptable diameter, and the subtraction of the tolerance will give us the minimum acceptable diameter.

The two problems that we need to solve are:

$$\begin{array}{r} 1.328 \\ +\ .015 \\ \hline \end{array} \quad \text{and} \quad \begin{array}{r} 1.328 \\ -\ .015 \\ \hline \end{array}$$

REVIEW OF DECIMALS

Sample Word Problem (Cont'd.)

Step 4: **Simply the problem if possible, and perform the math to solve the problem**. Write down your answer and check your math.

Solving the problems, we get the following answers:

$$\begin{array}{r} 1.328 \\ +\ .015 \\ \hline 1.343 \end{array} \quad \text{and} \quad \begin{array}{r} 1.328 \\ -\ .015 \\ \hline 1.313 \end{array}$$

Step 5: **Ask yourself, "is my answer reasonable?".**

Check your numbers—do they seem correct? If the tolerance was ±.015, then the maximum and minimum diameters should be .03 inches apart. (.015 inches above and .015 inches below = .015 + .015 = .03 inches between max. and min. diameters.) A quick way to check is to subtract the minimum diameter from the maximum diameter:

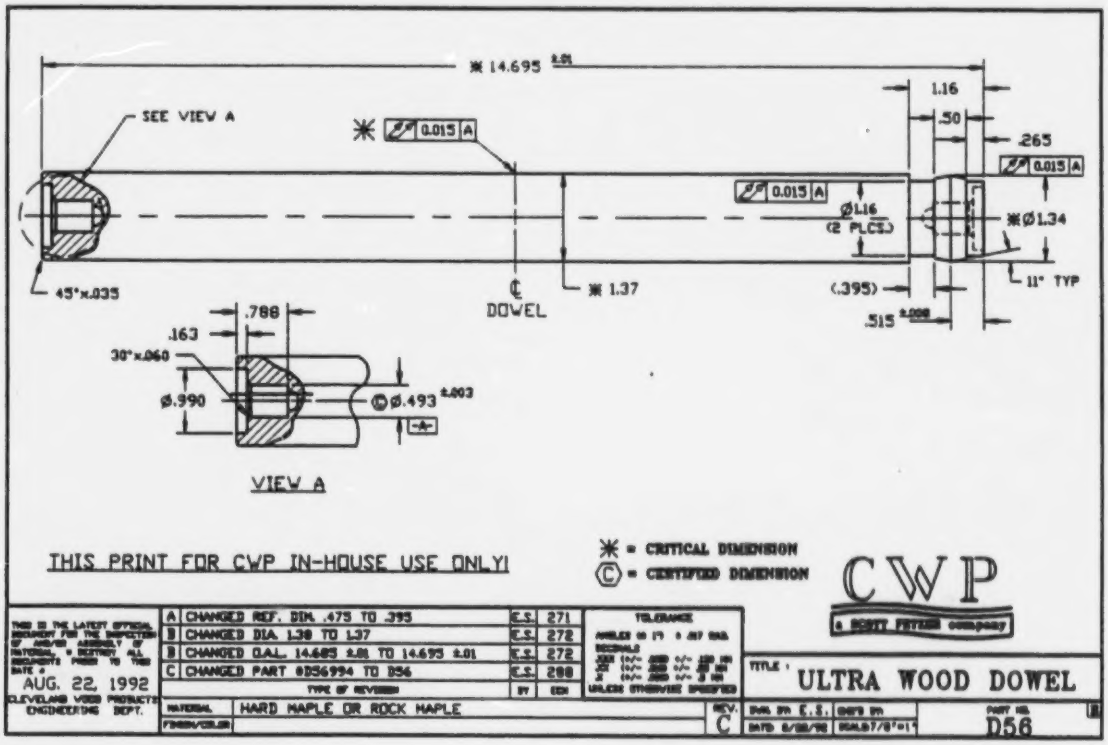
$$\begin{array}{r} 1.343 \\ -\ 1.313 \\ \hline 0.030 \end{array}$$

Our answer is indeed .03 inches, so our maximum and minimum diameters are probably correct.

REVIEW OF DECIMALS

Exercises: Solve the following decimal-related word problems.

1. Using the blueprint below, find the maximum and minimum acceptable length measurements for an Ultra wood dowel. Using the information on the blueprint, what are the maximum and minimum lengths which are still acceptable for this model of wood dowel?


✳ 14.695 ±.01
1.16
.50
.265
SEE VIEW A
✳ 0.015 A
0.015 A
0.015 A
Ø1.16 (2 PLCS.)
✳Ø1.34
45°×.035
℄ DOWEL
✳ 1.37
(.395)
11° TYP
.515 ±.008
.788
.163
30°×.060
Ø.990
©Ø.493 ±.003
A
VIEW A
THIS PRINT FOR CWP IN-HOUSE USE ONLY!
✳ = CRITICAL DIMENSION
© = CERTIFIED DIMENSION
CWP
AUG. 22, 1992
CLEVELAND WOOD PRODUCTS ENGINEERING DEPT.
A CHANGED REF. DIM. .475 TO .395 E.S. 271
B CHANGED DIA. 1.38 TO 1.37 E.S. 272
B CHANGED O.A.L. 14.685 ±.01 TO 14.695 ±.01 E.S. 272
C CHANGED PART #D56994 TO D56 E.S. 288
TYPE OF REVISION
TOLERANCE
MATERIAL HARD MAPLE OR ROCK MAPLE
REV. C
TITLE : ULTRA WOOD DOWEL
PART NO. D56

Answer: ______________________________

REVIEW OF DECIMALS

Exercises (cont'd.)

2. Using the blueprint in problem 1, Elaine needs to reduce the total length of the dowel by a factor of .788 for a new model. What would the new length of the wood dowel be? (Hint: multiply the current length by .788 to find the new length). Round your answer.

   Answer: ______________________________

3. John is checking a batch of Kirby ball bearing wood dowels, measuring the length of the dowels to make sure they are within specifications. The length specification for the dowels is 13.908 ± .010 inches. One dowel John measured had a length of 14.235 inches—how much longer than the maximum specification is the dowel's length?

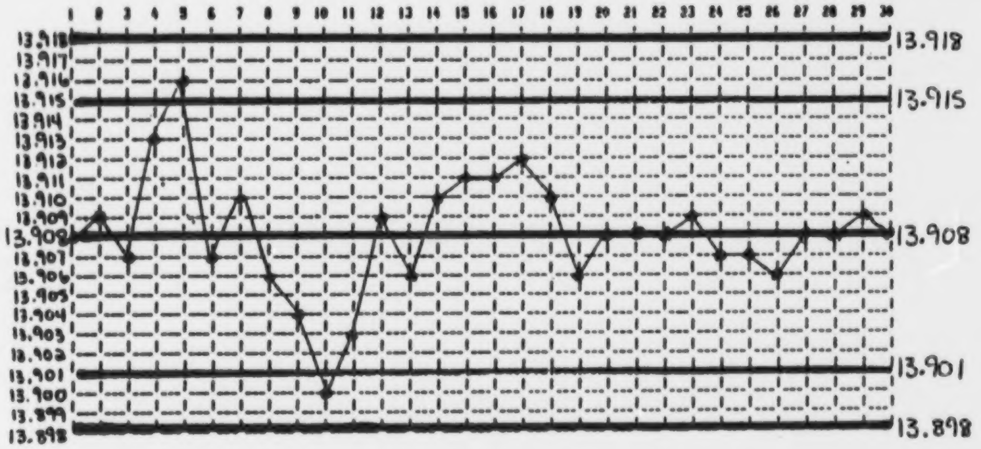
   Answer: ______________________________

REVIEW OF DECIMALS

Exercises (cont'd.)

Part Number: DBB
Part Name: Kirby Ball Bearing Wood Dowel
Date:
Shift:
Operator:
CLEVELAND WOOD PRODUCTS
PRE CONTROL CHARTS

Characteristic: Overall Length
Operation: CB/ Double Ender
Specification: 13.908 ±.010
Control Limits 13.908 ±.007
Gage: Height Gage #5002
Frequency: 2 pcs. every 2 hours



4. The control chart above shows 30 sample overall length measurements for a Kirby ball bearing wood dowel. What is the average length for the first 6 measurements? (Hint: Add the first six measurements and then divide by six.)

Answer: ______________________

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II

OBJECTIVES

SESSION 4

- ✓ Demonstrate ability to work with percentages
- ✓ Demonstrate ability to solve word problems involving percentages.

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MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

Definitions

Percent

Percent Sign (%)

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

What is a percent?

A percent is a fraction that always has 100 as a denominator. It can also be written in decimal format: 24% would be written in decimal format as 0.24, and 5% would be written as 0.05. The following shows how the same number can be written as a percent, a fraction, and a decimal:

35% is the same as $\frac{35}{100}$ is the same as 0.35

Percents are used as another way to represent part of a whole. As an example, they can be used to show how many answers were correct on a test—90% is the same as the fraction 90/100, or ninety correct out of a hundred questions. (This usually equals an "A", by the way.)

They are also used to for determining such diverse things as sales tax (usually around 6% of the total price), discounts (such as 30% off of normal retail price), commissions (a car salesperson may earn a 10% commission based on the sales price of a car they just sold, for example), and batting averages (a player hitting .351 is the same as saying they hit 35.1% of the pitches throw to them).

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

To indicate that a number is a percent, a percent sign (%) is placed immediately after the number (for example: 78%). No decimal point is used before numbers in the tenths and hundredths place.

Student Exercise

How many hundredths does each percent below indicate?

24% ________

75% ________

8.9% ________

1/2% ________

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

Finding a Percent of a Number

Finding a percent of a number is one of the most common operations with percents. It is done every time a salesperson has to calculate the sales tax on an item you just purchased—they need to find out how much to add to your total based on the sales tax rate in that city (such as 6%, 6.5%, or 7%).

To find the percent of a number, convert the percent to decimal format and multiply it by the number.

Example: Find 7% of 140

$7\% = \frac{7}{100} = 0.07$	Step 1: Convert 7% to a decimal
$0.07 \times 140 = 9.8$	Step 2: Multiply 0.07 by 140
9.8	The answer, 9.8, is 7% of 140

Example: Find 25% of 74

$25\% = \frac{25}{100} = 0.25$	Step 1: Convert 25% to a decimal
$0.25 \times 74 = 18.5$	Step 2: Multiply 0.25 by 74
18.5	The answer, 18.5, is 25% of 74

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

Student Exercise

1. Find 25% of 100 __________
2. Find 15% of 75 __________
3. Find 23% of 90 __________
4. Find 140% of 80 __________
5. Find 6% of 212 __________
6. Find 10% of 152 __________
7. Find 95% of 30 __________
8. Find 7% of 210 __________
9. Find 76% of 24 __________
10. Find 100% of 78 __________

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

Finding a Percent

Finding what percentage one number is of another can be very useful in comparing the two numbers. For example, say two brushes were defective out of a group of 10 which were produced. This may not seem like much, but when you see that those two defective brushes make up 20 percent of all the brushes made, it becomes clear that a significant amount of the brushes being produced are defective.

To find what percentage one number is of another, divide the number you wish to find the percentage for by the other number.

Example: 7 is what percent of 35?

$\frac{7}{35}$	Divide 7 by 35
$35 \overline{)7.00}^{\,0.20}$ -7 0	7 divided by 35 is 0.20
0.20 = 20%	Convert 0.20 into a percent (Multiply the decimal value by 100)
20%	7 is 20% of 35

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

Student Exercise

1. 7 is what percent of 100? __________
2. 10 is what percent of 40? __________
3. 12 is what percent of 120? __________
4. 337.5 is what percent of 450? __________
5. 40.5 is what percent of 45? __________
6. 4 is what percent of 80? __________
7. 42 is what percent of 120? __________
8. 9.6 is what percent of 80? __________
9. 100 is what percent of 50? __________
10. 45 is what percent of 90? __________

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

Finding the Original Number When a Percentage is Known

Sometimes it may be necessary to find the original number when only the percentage and the percent is known.

Example: Suppose you knew you paid \$.77 in sales tax for an item, and you knew the sales tax was 7%. What was the original price of the item?

$7\% = \frac{7}{100} = 0.07$	Step 1: Convert 7% to a decimal
$\frac{0.77}{0.07}$	Step 2: Divide 0.77 by 0.07
$\begin{array}{r} 11.0 \\ 0.\underset{\curvearrowright}{07}\,\overline{)\,0.\underset{\curvearrowright}{77}} \end{array}$	.77 divided by .07 is 11.0
\$11.00	\$.77 is 7% of 11 dollars

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

Student Exercise

1. 6 is 10% of what number? ____________

2. 25 is 50% of what number? ____________

3. 45 is 15% of what number? ____________

4. 70 is 28% of what number? ____________

5. 99 is 33% of what number? ____________

6. 25 is 20% of what number? ____________

7. 12 is 30% of what number? ____________

8. 36 is 75% of what number? ____________

9. 2.5 is 5% of what number? ____________

10. 76 is 95% of what number? ____________

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

Solving Word Problems Involving Percents

Review of Word Problems

Steps to Solve Word Problems:

1. **Determine what the question is.** What is the answer you are being asked to find?

2. **Identify the information you need to solve the problem.** Draw a sketch if possible to help visualize the problem.

3. **Identify what mathematical operation or operations to use.** Write down the equation you will need to solve.

4. **Simply the equation if possible, and perform the math to solve the problem.** Write down your answer and check your math.

5. **Ask yourself, "Is my answer reasonable?".**

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

Sample Word Problem Involving Percents

Out of 50 rejected brushes, 7 brushes were rejected because they were not properly locked in the bristler, 35 because they were caught in the trimmer, and 8 because the brushroll was smashed putting in bearings. What percent of the total number of rejected brushes were rejected because they got caught in the trimmer?

Step 1: **Determine what the question is.** What is the answer you are being asked to find?

What percentage of the 50 rejected brushes were caught in the trimmer?

Step 2: **Identify the information you need to solve the problem.** Draw a sketch if possible to help visualize the problem.

50 total rejected brushes
35 of those brushes were caught in the trimmer

Step 3: **Identify what mathematical operation or operations to use.** Write down the problem you will need to solve.

To find what percentage one number is of another, divide the number you wish to find the percentage for by the other number.

INTRODUCTION TO PERCENTS

Step 4: **Simply the problem if possible, and perform the math to solve the problem.** Write down your answer and check your math.

$\frac{35}{50}$	Divide 35 by 50
0.70 50) 35.00 -35 0	35 divided by 50 is 0.70
0.70 = 70%	Convert 0.70 into a percent (Multiply the decimal value by 100)
70%	35 is 70% of 50

Step 5: **Ask yourself, "Is my answer reasonable?"**

Does 35 seem like 70% of 50? Since half (50%) of 50 would be 25, 35 seems to be right. A quick way to check would be to multiply 50 by 70% (in decimal form, 0.70).

$50 \cdot 0.70 = 35$	70% of 50 is 35, so our calculation is correct.

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

Student Exercise

1. Production of brushes is averaging 12 defective brushes out of every 400 made. What is the percentage of defective brushes out of the total produced?

2. A 12-inch brush must be within 99% of its proper length to pass inspection. How short can a brush be and still pass inspection?

INTRODUCTION TO PERCENTS

3. The length specification for a Douglas ball bearing brushroll assembly is 12 inches, plus or minus 0.024 inches. What percentage shorter than 12 inches can a brushroll actually be and still be within the required specification?

4. Out of 120 rejected brushes, 37 brushes were rejected because they were not properly locked in the bristler, 55 because they were caught in the trimmer, and 28 because the brushroll was smashed putting in bearings. What percent of the total number of rejected brushes were rejected because the brushroll was smashed?

INTRODUCTION TO PERCENTS

5. On Monday, workers on the first shift each produced an average of 45 pieces per man hour. The second shift produced an average of 41 pieces per man hour, and the third shift produced an average of 36 pieces per man hour. What percentage did the first shift produce compared to the third shift's average?

6. On Monday, Mark produced 315 pieces. On Tuesday he produced 338, on Wednesday 310, on Thursday 325, and on Friday 322. What percentage of Mark's total for the week did he produce on Friday?

INTRODUCTION TO PERCENTS

7. Denise was measuring brush rollers. The diameter specification for the rollers was 2.50 inches. The brush roller Denise measured had a diameter of 2.05 inches. What percentage of the specified diameter was the roller that Denise measured?

8. A new bristler was installed. To insure that it is working correctly, the machine is tested. If it is working properly, the reject rate for brush rollers processed on the machine should be no higher than 5%. On a test run of 500 brush rollers, 30 rollers failed inspection and were rejected. What was the percent of rejected rollers, and did the machine pass testing?

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II

OBJECTIVES

SESSION 5

- ✔ Demonstrate ability to convert between fractions, decimals, and percents.
- ✔ Set up and solve word problems involving conversion between fractions, decimals, and percents.

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MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Definitions

Fractions

Decimals

Percents

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Fractions to Decimals

To convert a fraction to a decimal, simply divide the denominator into the numerator and carry out the division to the desired number of decimal places.

Examples: Change 3/4 to a decimal

```
      .75
  4 ) 3.00
     -2 8
       20
      -20
        0
```

To change the fraction 3/4 into a decimal, divide three by four.

Change 25/32 to a decimal. Round to 3 decimal places.

```
         .78125
 32 ) 25.00000
     -22 4
        2 60
       -2 56
           40
          -32
            80
            64
           160
           160
```

To change the fraction 25/32 into a decimal, divide 25 by 32. Rounding the answer of .78125 to three decimal places, we come up with .781 as the answer.

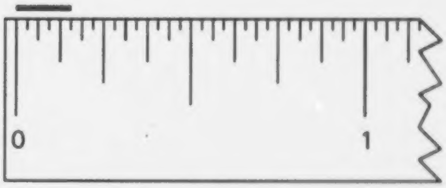
MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

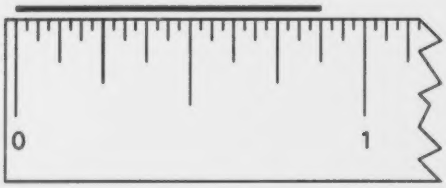
Converting Fractions to Decimals

Exercise

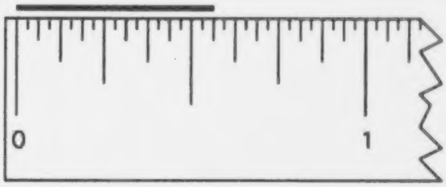
Convert the following fractional ruler measurements to decimal format:



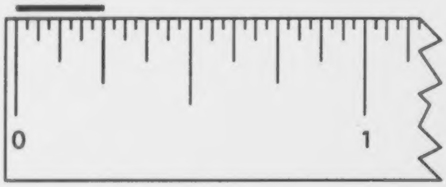
Answer: __________



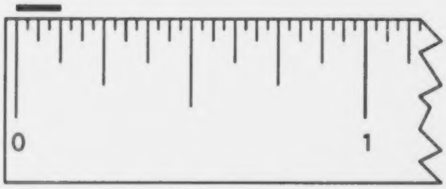
Answer: __________



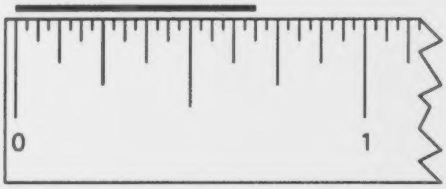
Answer: __________



Answer: __________



Answer: __________



Answer: __________

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Fractions to Percents

To convert a fraction to a percent, divide the denominator into the numerator to find the decimal equivalent. Then, move the decimal point 2 places to the right and add a percent sign.

Example: Change 1/8 to a percent

$$\begin{array}{r} .125 \\ 8\,\overline{)\,1.000} \\ \underline{-8} \\ 20 \\ \underline{-16} \\ 40 \\ \underline{-40} \\ 0 \end{array}$$

First, divide 1 by 8

.125 = 12.5%

Then convert your answer into a percent by multiplying it by 100 (hint: move the decimal place two places to the right).

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Fractions to Percents

Exercise

Convert each of the following fractions to percents. Carry out your answers to 3 decimal places.

1. $\frac{4}{5}$
2. $\frac{7}{8}$
3. $\frac{9}{16}$
4. $\frac{7}{10}$
5. $\frac{3}{16}$
6. $\frac{11}{32}$
7. $\frac{3}{4}$
8. $\frac{5}{8}$
9. $\frac{1}{32}$
10. $\frac{1}{5}$

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Decimals to Fractions

To convert a decimal to a fraction:

1. Write the decimal as a fraction by:

   a. Writing the digits to the left of the decimal point as the numerator. Do not include the decimal point.

   b. Write the multiple of ten indicated by place value as the denominator.

2. Reduce this fraction to lowest terms. A fraction is reduced to lowest terms when the numerator and denominator cannot be divided evenly by the same number.

Example: Convert .125 to a fraction.

$.125 = 125/1000$	.125 is equal to 125 over 1000.
$\frac{125 \div 25}{1000 \div 25} = \frac{5}{40}$	Reduce fraction.
$\frac{5 \div 5}{40 \div 5} = \frac{1}{8}$	.125 is equal to $\frac{1}{8}$

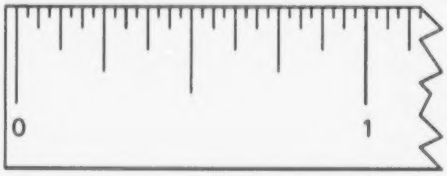
MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

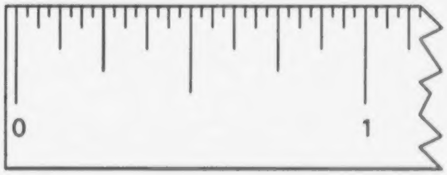
Converting Decimals to Fractions

Exercise

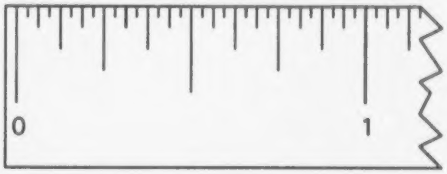
Convert the following decimals to fractions. Then, draw your answer as a length on the ruler.



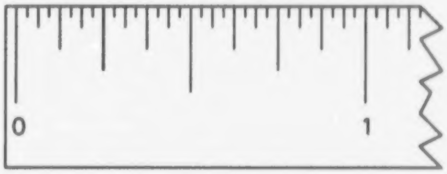
.5625 Answer: _____



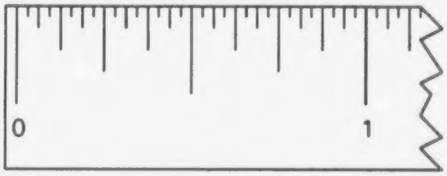
.6875 Answer: _____



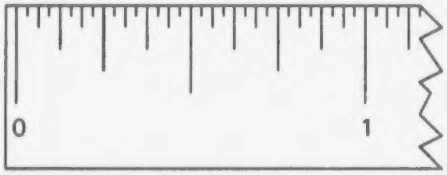
.375 Answer: _____



.875 Answer: _____



.125 Answer: _____



.25 Answer: _____

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Decimals to Percents

To convert a decimal to a percent is one of the easiest conversions. move the decimal point 2 places to the right and add the percent sign (%) to your answer. This is the same as multiplying the number by 100—remember that a percent is a portion (a *percentage*) of 100.

Examples: Convert the following decimal numbers to percents.

$\underset{\curvearrowright}{.8}6 = 86\%$	Multiply .86 by 100 (.86 x 100 = 86) , then add the percent (%) sign. As a shortcut, just move the decimal place two places to the right.
$\underset{\curvearrowright}{.9}7543 = 97.543\%$	Multiply .97543 by 100 by moving the decimal place two places to the right, then add the percent (%) sign.

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Decimals to Percents

Exercise

Convert the following decimals to percents:

1. .823
2. .7983
3. 1.00
4. .05
5. .23
6. .25431
7. 1.10
8. .5678
9. .2734
10. .005
11. .29
12. .789
13. .9999
14. 0
15. .8801
16. 2.25
17. .02157
18. .243
19. .5499
20. .0001

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Percents to Fractions

To convert a percent to a fraction:

1. Write the percent as a fraction by
    - a. Writing the digits of the percent as the numerator. Do not include the percent sign.
    - b. Write 100 as the denominator.
2. Reduce this fraction to lowest terms. A fraction is reduced to lowest terms when the numerator and denominator cannot be divided evenly by the same number.

Examples: Convert 86% to a fraction.

86% = 86/100 — 86% is equal to 86 over 100.

$$\frac{86}{100} \div \frac{2}{2} = \frac{43}{50}$$

Reduce.

Convert 25% to a fraction.

25% = 25/100 — 25% is equal to 25 over 100.

$$\frac{25}{100} \div \frac{25}{25} = \frac{1}{4}$$

Reduce.

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Percents to Fractions

Exercise

Convert the following percents to fractions. Reduce to lowest terms if possible.

1. 67% Answer: _______

2. 4% Answer: _______

3. 110% Answer: _______

4. 5% Answer: _______

5. 73% Answer: _______

6. 20% Answer: _______

7. 33.333% Answer: _______

8. 50% Answer: _______

9. 80% Answer: _______

10. 21% Answer: _______

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Percents to Decimals

To convert a percent to a decimal, just move the decimal point 2 places to the left and drop the percent sign. This is the same as dividing the number by 100 (remember that a percent is a portion of 100).

Examples: Convert the following percents to decimals.

86. % = .86

Divide 86% by 100 (86 ÷ 100 = .86), and remove the percent (%) sign. As a shortcut, just move the decimal place two places to the left.

159. % = 1.59

Move the decimal two places to the left, and remove the percent sign.

3. % = .03

Use the same procedure as above. If necessary, just add a zero in front of the number.

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Percents to Decimals

Exercise

Convert the following percents to decimals.

1. 85%
2. 100%
3. 73%
4. 5%
5. .23%
6. 25.431%
7. 1.1%
8. 56.78%
9. 273.4%
10. 10%
11. .29%
12. 54.1%
13. 99.99%
14. 0%
15. 23.57%
16. 2.25%
17. 215.7%
18. 70%
19. 54.99%
20. .01%

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Solving Word Problems Involving Converting

Example

Mike has to adjust the bristler for a new model of brush roller. The new length for a brush roller is specified as being 88% of the current length, which is 12 1/8 inches. What is the new length?

Step 1: **Determine what the question is**. What is the answer you are being asked to find?

What is the new brush roller length. We need to find the length that is 88% of 12 1/8.

Step 2: **Identify the information you need to solve the problem**. Draw a sketch if possible to help visualize the problem.

Current brush length:	12 1/8 inches
New brush length:	88% of 12 1/8

Step 3: **Identify what mathematical operation or operations to use.** Write down the problem you will need to solve.

We need to multiply 12 1/8 by 88%.

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Step 4: **Simply the problem if possible, and perform the math to solve the problem.** Write down your answer and check your math.

The best way to simplify the problem is to convert both the length and the percentage into decimal format, then multiply them:

$$\begin{array}{r} .125 \\ 8\,\overline{)\,1.000} \\ \underline{-8} \\ 20 \\ \underline{-16} \\ 40 \\ \underline{-40} \\ 0 \end{array}$$

Convert the fractional part of 12 1/8 into decimal format.

Add the result (.125) to the whole number part of 12 1/8 (12).

12 1/8 = 12.125 — Original length in decimal format.

$\underset{\curvearrowleft}{88.}\,\% = .88$ — 88% = .88 in decimal format

12.125 x .88 = 10.67 — 88% of 12 1/8 is 10.67 inches.

Step 5: **Ask yourself, "Is my answer reasonable?".**

Does 10.67 inches sound correct? A quick way to check is to round the numbers in the problem and do a rough calculation. Round 12 1/8 to 12, and 88% to 80%, then multiply 12 by .8 (the decimal format of 80%)

12 x .8 = 9.6 inches, which is close to 10.67. While this doesn't guarantee that our answer is correct, it does show us that our answer is at least in the right ballpark, and is reasonable.

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Solving Word Problems Involving Converting

Exercises

1. Janice measures the diameter of a brushroll. The digital display on the micrometer reads 1.328. The specified diameter is 1 3/8 inches, and the piece must be within 2% of the specified diameter to pass inspection. Does this brushroll pass, and if it doesn't, how much longer/shorter is it than the specified diameter?

   Answer: __________

2. The specified length of a Douglas Ball Bearing brushroll is 12.115 inches, plus or minus 1/40th of an inch. What is the longest length that a brushroll can be (in decimal format) and still pass inspection?

   Answer: __________

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Solving Word Problems Involving Converting

Exercises (cont'd.)

3. A older brushroll is 88% of the length of a new brushroll specification. If the old brushroll is 11 inches long, how long will the new brushroll be (in fraction format)?

   Answer: ___________

4. During their shift, each person completed a certain amount of pieces. If Mark completed 5/8 of a carton, Michelle completed 27% of a carton, and Maggie completed 1 2/5 cartons, how many total cartons were processed (in decimal format?)

   Answer: ___________

OBJECTIVES

SESSION 6

- ✔ Understand and use a number line.
- ✔ Understand the concept of positive and negative integers.
- ✔ Demonstrate ability to add and subtract positive and negative integers.

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MATHEMATICS ON THE JOB II
SESSION 6

POSITIVE AND NEGATIVE NUMBERS

Definitions

Negative Numbers:

Number Line:

Absolute Value:

Positive Numbers

Signed Numbers:

MATHEMATICS ON THE JOB II
SESSION 6

Signed Numbers

One of the first concepts in algebra is the concept of **signed numbers**, which includes both positive and negative numbers. A thermometer is a good example of the use of positive and negative numbers—all temperature readings above 0 degrees are **positive** temperatures, and all readings below 0 are **negative** temperatures.

Negative numbers have a negative sign (–) in front of the number. For example, negative seven would be written as –7. All negative numbers are less than zero.

Positive numbers have either a positive sign (+) in front of the number, or no sign at all. For example, positive 5 can be written as +5 or just 5. Positive numbers are greater than zero.

The number zero (0) marks the 'dividing line' between negative and positive numbers. Zero itself is neutral and is not considered positive or negative.

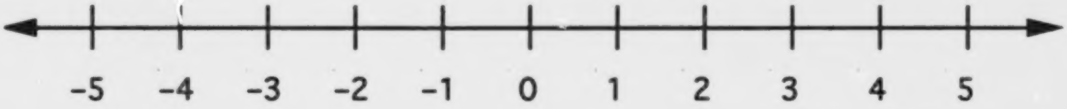
Student Exercise

Mark each number as being either Positive (+), Negative (–), or Neither (N):

1. +7 __________
2. –4 __________
3. +5 __________
4. 8 __________
5. –9 __________
6. +2 __________
7. –6 __________
8. 0 __________
9. 2 __________
10. –3 __________

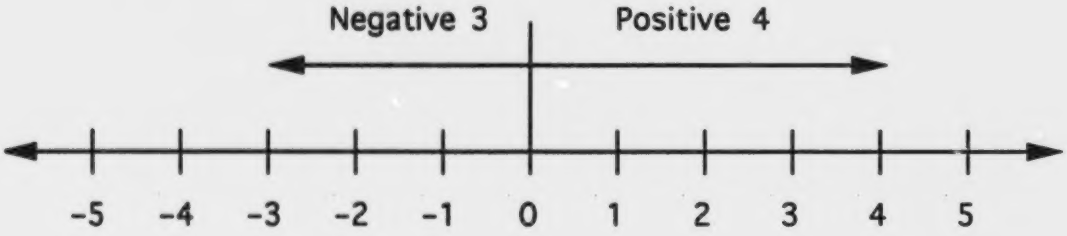
The Number Line

A handy tool in showing signed numbers is the **number line**, which can be used to show how signed numbers relate to each other. The following is a sample number line:



Zero is the 'middle point' on a number line. Notice how the positive numbers are on the right side of zero, and the negative numbers are on the left side of zero. Positive numbers increase as you move to the right, and negative numbers increase as you move to the left.

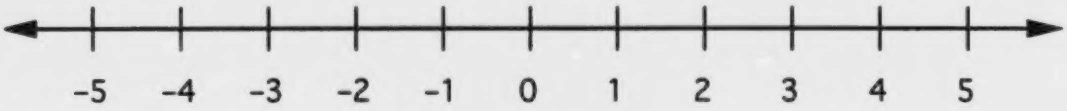
To show the "size" of a signed number, a **number arrow** can be drawn. The length of the arrow shows the size of the number. The number line below shows two number arrows, one for –3 and one for +4:



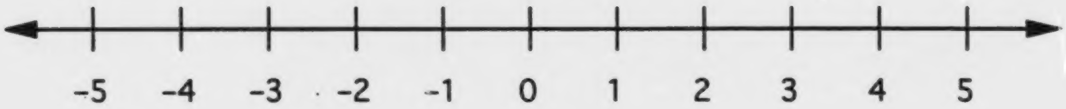
MATHEMATICS ON THE JOB II
SESSION 6

Student Exercise

1. Locate the following numbers on the number line: 4, −2, +5, −5, +3


−5
−4
−3
−2
−1
0
1
2
3
4
5

2. Draw a number arrow for these numbers: −4, 5

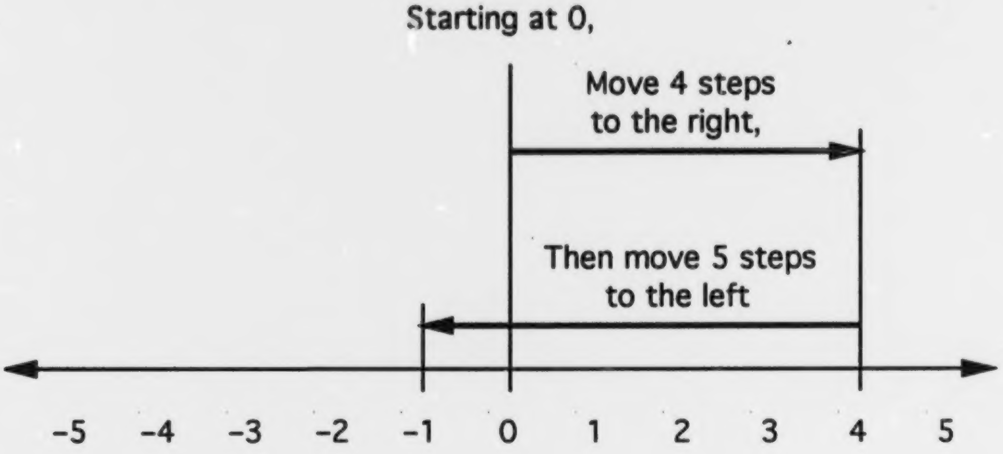

−5
−4
−3
−2
−1
0
1
2
3
4
5

Adding Signed Numbers

Adding two signed numbers can be a little confusing, since the positive (+) sign can mean a positive number (such as +56) or addition (5 + 7), and the negative (–) sign can mean a negative number (such as –23) or subtraction (5 – 6). To simplify things, signed numbers are often enclosed in parentheses when being added or subtracted. For example:

+5 + (+6)
(–5) + (+4)
(–2) + (–6)

Adding signed numbers can be thought of as moving right and left on a number line. For example, +4 + (–5) could be thought of as "Starting at Zero, move four steps to the right, then move five steps to the left". You end up one step to the left of zero, at –1.


Starting at 0,
Move 4 steps to the right,
Then move 5 steps to the left
–5
–4
–3
–2
–1
0
1
2
3
4
5

Adding Signed Numbers: Rule 1

RULE 1: **When adding two numbers with the same sign, add the numbers and give the answer the same sign as the numbers.**

EXAMPLE: Add +3 and +4. Note: this could also be written (+3) + (+4).

To add these two numbers, first add the numbers (3 + 4 = 7), then give the answer the same sign (+) as the two numbers. The resulting answer is +7. The sum of any two positive numbers will always be positive.

EXAMPLE: Add –2 and –5. This could be written as (–2) + (–5).

Once again, add the two numbers (2 + 5 = 7), then give the answer the same sign (–) as the two numbers. This time, the answer is –7. The sum of any two negative numbers is always negative.

Student Exercise Add the following signed numbers:

1. +5 + (+3) = __________
2. –2 + (–13) = __________
3. +8 + (+16) = __________
4. –9 + (–13) = __________
5. –12 + (–7) = __________
6. +13 + (+19) = __________
7. –12 + (–21) = __________
8. –7 + (–8) = __________
9. +15 + (+21) = __________
10. +7 + (+8) = __________

MATHEMATICS ON THE JOB II
SESSION 6

Adding Signed Numbers: Rule 2

RULE 2: **To add two numbers with different signs, subtract the smaller number from the larger number, then give the answer the sign of the larger number.**

EXAMPLE: Add +5 and –2. This would be written as (+5) + (–2).

Your first step would be to subtract the smaller number from the larger number. For our example, you would subtract 2 from 5 (5 – 2 = 3). Next, you give the answer (3) the sign of the larger number (in our example, +5 is the larger number). The final answer would be +3. Note that any time a negative number is added to a positive number, it is the same as subtracting that negative number from the positive number. For example, 5 + (–2) could be re–written 5 – 2.

EXAMPLE: Add –7 and +3. This would be written as (–7) + (+3), or 3 – 7 (see previous example.)

Step one is to subtract the smaller number from the larger one (7 – 3 = 4). Step two is taking the sign from the larger of the two numbers (–7) and giving it to the answer. The answer to (–7) + (+3) would be –4.

Student Exercise Add the following signed numbers:

1. +5 + (–3) = __________
2. –3 + (+12) = __________
3. +5 + (–19) = __________
4. –9 + (+13) = __________
5. +14 + (–7) = __________
6. +9 + (–12) = __________
7. –13 + (+22) = __________
8. –7 + (+8) = __________
9. +14 + (–23) = __________
10. +6 + (–13) = __________

MATHEMATICS ON THE JOB II
SESSION 6

Adding Signed Numbers: Rule 3

RULE 3: **To add several numbers, combine the positive numbers first, then combine the negative numbers, then add the positive and negative totals.**

EXAMPLE: Add –15, +4, –2, –7, +13 and +9.

Step 1: Add the positive and negative numbers separately:

(+4) + (+13) + (+9) = +26
(–15) + (–2) + (–7) = –24

Step 2: Add the positive and negative totals:

(+26) + (–24) = +2

Student Exercise Add the following sets of numbers:

1. –4, +5, +9, –11, +12, –3 __________
2. –6, +7, +11, +9, –13, –9, +4 __________
3. –2, +10, +8, –15, –3, +7, +3 __________
4. –5, +5, –3, –12, +12, +3 __________
5. –8, +6, –12, +10, –2, +7 __________

Subtracting Signed Numbers

To subtract signed numbers, just change the sign of the number that is being subtracted, then follow the steps for adding two signed numbers. Subtracting a positive number is the same as adding a negative number.

EXAMPLE: Subtract +7 from +9. This can be written as +9 – (+7).

First, change the +7 to –7. The equation then becomes +9 + (–7). Using the rules for adding two signed numbers, we find that the answer is 2.

EXAMPLE: Subtract –7 from +9. This can be written as +9 – (–7).

First, change the –7 to +7. The equation then becomes +9 + (+7). Using the rules for adding two signed numbers, we find that the answer is 16.

Student Exercise Subtract the following signed numbers:

1. +5 – (+3) = __________
2. –2 – (–13) = __________
3. +8 – (+16) = __________
4. –9 – (–13) = __________
5. –12 – (–7) = __________
6. +13 – (+19) = __________
7. –12 – (–21) = __________
8. –7 – (–8) = __________
9. +15 – (+21) = __________
10. +7 – (+8) = __________

Adding and Subtracting Signed Numbers in the Same Equation

Sometimes an equation will include both addition and subtraction of signed numbers, such as: $(-7) + (+9) - (-7) - (+12) + (+3) =$

To solve an equation that involves both adding and subtracting signed numbers, use the following steps:

Step 1: Change the sign of every number being subtracted, and change the subtraction sign to an addition sign. For example, the equation $9 - (-8)$ becomes $9 + (+8)$.

Step 2: Combine the positive numbers and the negative numbers separately.

Step 3: Find the difference between the two totals, and give your answer the sign of the larger number.

EXAMPLE: Solve the following equation: $(+8) - (-7) + (+8) - (+3) - (-4) + (-7) =$

Step 1: Change the sign of every number being subtracted. –7 becomes +7, +3 becomes –3, and –4 becomes +4. Then change each of the subtraction signs to addition signs: $(+8) + (+7) + (+8) + (-3) + (+4) + (-7)$

Step 2: Combine positive numbers and negative numbers separately:
$(+8) + (+7) + (+8) + (+4) = +27$
$(-3) + (-7) = -10$

Step 3: Find the difference, then give the answer the sign of the larger number:
$(+27) + (-10) = +17$

MATHEMATICS ON THE JOB II
SESSION 6

Student Exercise Solve the following equations:

1. $(+10) - (-18) + (-7) - (+12) + (+7) =$ __________

2. $(+11) + (-12) - (+6) + (+8) - (-3) + (-7) =$ __________

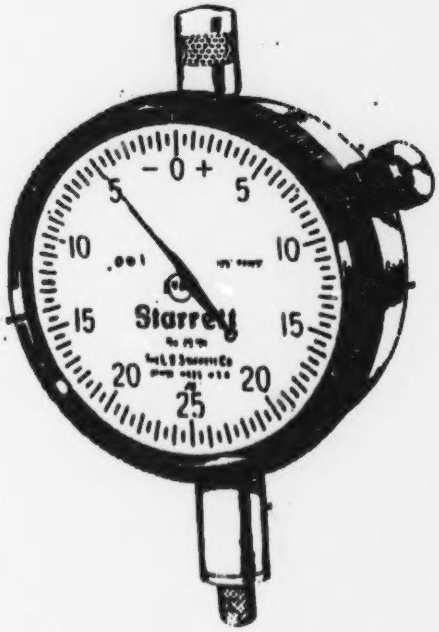
3. $(-13) - (+12) - (-18) + (+7) - (+6) - (-2) =$ __________

4. $(-8) + (-6) - (+5) - (-3) + (+8) + (-5) =$ __________

5. $(-3) + (+13) - (+5) - (-6) + (-11) - (-8) =$ __________

Workplace Application: Comparator Readings

A comparator is a measuring device used to compare variations in some aspect of an produced item, such as the variations in the length of manufactured brushrolls. A comparator uses a dial to show how much above or below the correct length a brushroll actually is.

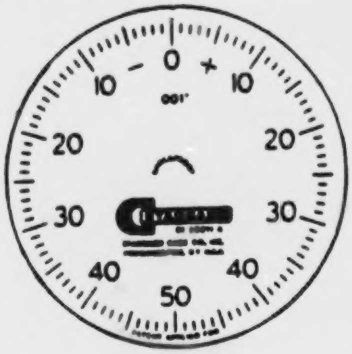


Notice that the numbers go both clockwise and counter-clockwise, starting at the top of the dial. The numbers moving clockwise are positive numbers (notice the "+" sign on the dial between the 0 and the 5 to the right), and the numbers moving counter-clockwise are negative numbers (again, notice the "–" sign between the 0 and 5 to the left.) A positive number indicates the piece being measure is longer than the length expected, while a negative number indicates the piece is shorter than the expected length.

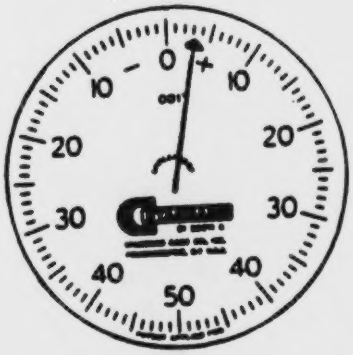
MATHEMATICS ON THE JOB II
SESSION 6

The degree of accuracy for a comparator depends on how the dial is graduated or scaled. To discover how a dial is graduated, look at the dial's faceplate. A number will be printed there which tells you the graduation.

On the dial below, the graduation is .001, so we know the dial is graduated in thousandths. Each mark on the dial represents one thousandth of an inch.



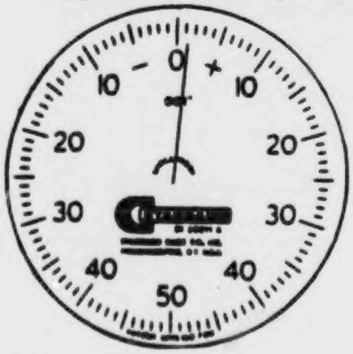
If a measurement was taken, and the needle was three lines away from zero (see below), the dial needle would be read as being at three thousandths, or .003 inches.



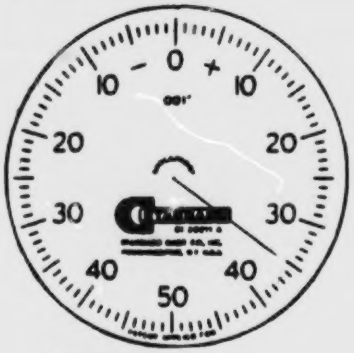
Some of the lines on the dial are marked with an multiple of 10 (10, 20, 30, etc.). Each of these marks represents 10 thousandths, or more properly, 1 hundredth of an inch.

MATHEMATICS ON THE JOB II
SESSION 6

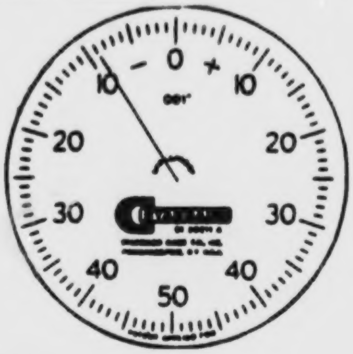
Exercise: Read the following dials. Express your answer as either a positive or negative decimal (for example, +.003 or –.051)


- 0 +
10 10
.001"
20 20
30 30
40 40
50

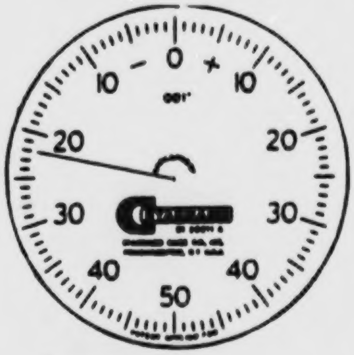
Answer: ________


- 0 +
10 10
.001"
20 20
30 30
40 40
50

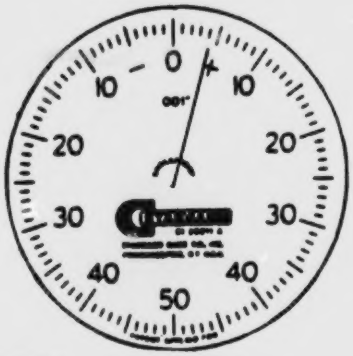
Answer: ________


- 0 +
10 10
.001"
20 20
30 30
40 40
50

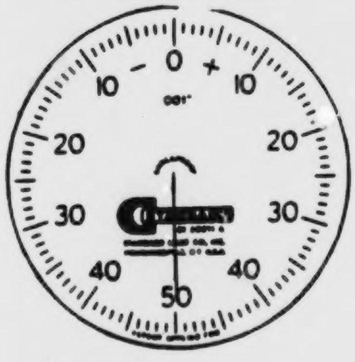
Answer: ________


- 0 +
10 10
.001"
20 20
30 30
40 40
50

Answer: ________


- 0 +
10 10
.001"
20 20
30 30
40 40
50

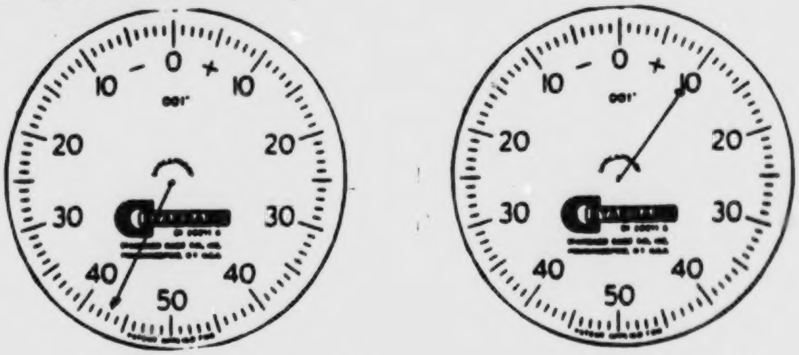
Answer: ________


- 0 +
10 10
.001"
20 20
30 30
40 40
50

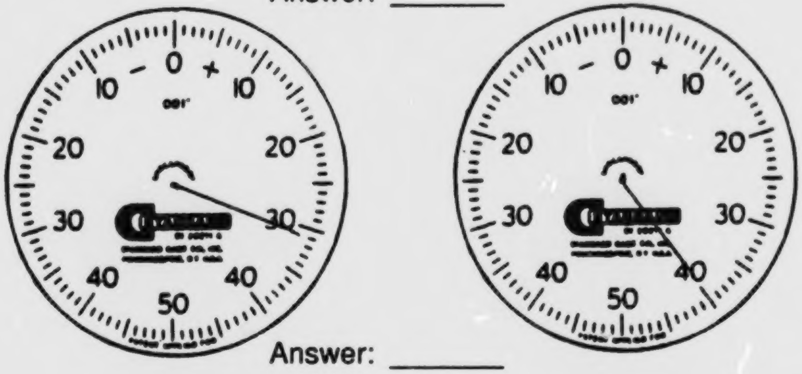
Answer: ________

MATHEMATICS ON THE JOB II
SESSION 6

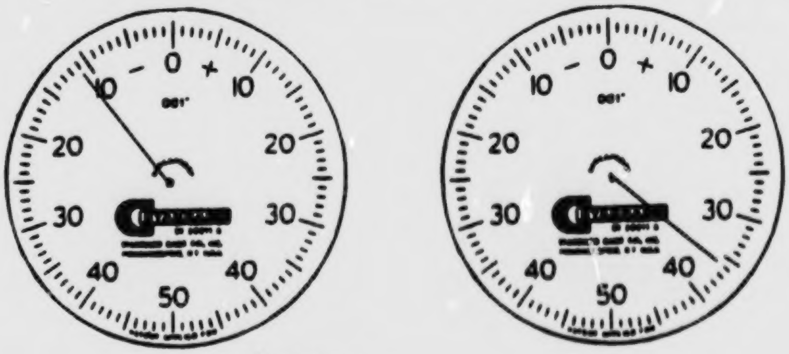
Exercise: Read the following pairs of dials, and add the two readings together. Express your answer as either a positive or negative decimal (for example, +.003 or –.051)


10 – 0 + 10
.001"
20
20
30
30
40
40
50

Answer: ______


10 – 0 + 10
.001"
20
20
30
30
40
40
50

Answer: ______


10 – 0 + 10
.001"
20
20
30
30
40
40
50

Answer: ______

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II

OBJECTIVES

SESSION 7

- ✔ Demonstrate ability to multiply and divide positive and negative integers.
- ✔ Understand and apply the rules for order of operations to solve equations.

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MATHEMATICS ON THE JOB II
SESSION 7

Definitions

Absolute Value:

Negative Numbers:

Order of Operations:

Positive Numbers:

Signed Numbers:

MATHEMATICS ON THE JOB II
SESSION 7

Review of Positive and Negative Integers

A thermometer is a good example of the use of positive and negative integers—all temperature readings above 0 degrees are **positive** temperatures, and all readings below 0 are **negative** temperatures.

Negative integers have a negative sign (–) in front of the number. For example, negative seven would be written as –7. All negative integers are less than zero.

Positive integers have either a positive sign (+) in front of the number, or no sign at all. For example, positive 5 can be written as +5 or just 5. Positive integers are greater than zero.

The number zero (0) marks the 'dividing line' between negative and positive integers. Zero itself is neutral and is not considered positive or negative.

Adding Signed Integers

Adding two signed integers can be a little confusing, since the positive (+) sign can mean a positive integer (such as +56) or addition (5 + 7), and the negative (–) sign can mean a negative integer (such as –23) or subtraction (5 – 6). To simplify things, integers are often enclosed in parentheses when being added or subtracted.

RULE 1: When adding two integers with the same sign, add the integers and give the answer the same sign as the integers.

RULE 2: To add two integers with different signs, subtract the smaller number from the larger number, then give the answer the sign of the larger number.

RULE 3: To add several integers, combine the positive integers first, then combine the negative integers, then add the positive and negative totals.

Subtracting Signed Integers

To subtract signed integers, change the sign of the number that is being subtracted, then follow the steps for adding two signed integer. Subtracting a positive number is the same as adding a negative number.

Adding & Subtracting Signed Integers in the Same Equation

Sometimes an equation will include both addition and subtraction of signed integers, such as: (−7) + (+9) − (−7) − (+12) + (+3) =. To solve an equation that involves both adding and subtracting signed integers, use the following steps:

Step 1:	Change the sign of every number being subtracted, and change the subtraction sign to an addition sign.
Step 2:	Combine the positive integers and the negative integers separately.
Step 3:	Find the difference between the two totals, and give your answer the sign of the larger number.

MATHEMATICS ON THE JOB II
SESSION 7

Activity 1:

Average Daily Variation in Brushroll Length Measurements

Exercise: Find the average daily variation in the length of sample brushrolls.

(Hint: to find the average variation, total each column, and divide that total by the number of measurements taken that day. Give your answer the same sign as the sign of the total for that day.)

Day:	Mon	Tue	Wed	Thu	Fri
Reading 1	+.05	−.02	+.32	+.33	+.11
Reading 2	−.15	+.31	+.12	+.15	−.21
Reading 3	−.21	+.20	+.07	+.10	−.02
Reading 4	+.11	Skipped	−.03	+.02	−.09
Reading 5	+.01	−.07	+.01	−.18	+.02
Reading 6	−.09	−.04	+.13	+.21	−.05
Reading 7	+.02	−.04	+.11	−.16	−.10
Reading 8	−.01	+.05	−.21	Missed	+.14
Reading 9	−.37	+.11	+.03	−.21	Shut down
Reading 10	+.23	−.23	−.15	+.28	Shut down
Average Variation					

Multiplying Signed Numbers

To multiply two signed numbers, follow these two simple rules:

RULE 1: If the signs of the two numbers being multiplied are alike, multiply the numbers and give the answer a positive sign.

RULE 2: If the signs of the two numbers being multiplied are different, multiply the numbers and give the answer a negative sign.

Note: In algebra, multiplication is indicated by a dot "•" or parentheses ( ), instead of the "x" used in arithmetic. 5 x 6 would instead be written as $5 \cdot 6$ or $5\,(6)$.

EXAMPLE: Multiply +5 and +3.

First, multiply the two numbers: $5 \cdot 3 = 15$. Next, since both numbers have the same sign, the answer will have a positive sign: +15.

EXAMPLE: Multiply –5 and +3.

Once again, multiply the two numbers: $5 \cdot 3 = 15$. This time the two numbers have different signs, so the answer will have a negative sign instead of a positive sign: –15.

Multiplying Groups of Signed Numbers

To multiply groups of signed numbers, simply multiply them one group at a time.

EXAMPLE: Solve (+5)(–2)(+3)(–6).

First, multiply (+5)(–2). Using the rules above, we multiply 5 times 2 and make the answer negative since the two numbers had different signs. The answer is –10.

Next, we multiply (–10)(+3). Again, we use the rules for multiplying signed numbers listed above. This time the answer is –30.

Finally, we multiply (–30)(–6), which gives us the final answer of +180.

MATHEMATICS ON THE JOB II
SESSION 7

Student Exercise Solve the following multiplication problems:

1. $(+5)(-8) =$
2. $(-3)(-6) =$
3. $(+6)(-6) =$
4. $(+7)(+10) =$
5. $-8 \cdot +6 =$
6. $(-9)(+5) =$
7. $+10 \cdot -6 =$
8. $(+11)(-10) =$
9. $(-9)(-9) =$
10. $(-12)(+11) =$
11. $+12 \cdot +8 =$
12. $(-6)(+9) =$
13. $(+11)(-9) =$
14. $(-8)(-12) =$
15. $(+6)(+5) =$
16. $(+6)(-3)(+3) =$
17. $(-5)(-2)(+6)(-2) =$
18. $(-2)(+3)(+6)(-4)$
19. $+6 \cdot -2 \cdot +4 \cdot -3 =$
20. $(-3)(+5)(-3)(+4) =$

MATHEMATICS ON THE JOB II
SESSION 7

Dividing Signed Numbers

To divide two signed numbers, follow these two rules:

RULE 1: If the signs of the two numbers being divided are alike, divide the numbers and give the answer a positive sign.

RULE 2: If the signs of the two numbers being divided are different, divide the numbers and give the answer a negative sign.

Note: In algebra, division is indicated by a standard division symbol (÷) or a fraction bar (such as 6/7).

EXAMPLE: Divide +15 by +3.

First, divide the numbers: 15 ÷ 3 = 5.

Next, since the signs are alike, give the answer a positive sign: +5.

EXAMPLE: Divide –36 by +4.

First, divide the numbers: 36 ÷ 4 = 9.

Next, since the signs are different, give the answer a negative sign: –9.

MATHEMATICS ON THE JOB II
SESSION 7

Student Exercise Solve the following division problems.

1. $-48 \div +4 =$
2. $+62 \div -2 =$
3. $-81 \div -3 =$
4. $-35 \div +7 =$
5. $+49 \div +7 =$
6. $+24 \div -6 =$
7. $+144 \div +12 =$
8. $-54 \div -3 =$
9. $-65 \div +5 =$
10. $-70 \div -7 =$

Order of Operations

Sometimes, the answer to an equation may not be obvious. $2 + 4$ is 6, but what is the answer to $2 + 4 \cdot 3 = ?$ If you add 2 and 4, then multiply the answer (6) by 3, you get 18. If you multiply 3 and 4, then add the answer (12) to 2, you get 14. Is the correct answer 14 or 18? To properly solve these types of equations, you need to know in what order you will need to perform these operations.

These rules are called the **Order of Operations**, and are listed below:

1. First, all operations in parentheses ( ) or bracket [ ] must be evaluated. If there are parentheses inside of parentheses (called nested parentheses), solve the equations in the innermost parentheses first.

2. Next, all exponents should be evaluated.

3. Next, all multiplications and divisions should be evaluated, working from left to right in the equation.

4. Lastly, evaluate all additions and subtractions, again working from left to right in the equation.

Using these rules, we see that $2 + 4 \cdot 3 = 14$, because we should perform the multiplication part ($4 \cdot 3 = 12$) first, then the addition part ($2 + 12 = 14$), which gives us the correct answer of 14.

Step 1: Parentheses

The first step in evaluating an equation is to evaluate all operations in parentheses () or brackets [ ]. If there are parentheses inside of parentheses (called nested parentheses), solve the equation in the innermost parentheses first.

EXAMPLE: Solve (4 + 5) • 2

Evaluating the parentheses first (4 + 5) gives us 9, which multiplied by 2 gives us our answer of 18.

EXAMPLE: Solve (((4 + 5) • 2) + 4) ÷ 2

First we evaluate the innermost parentheses: (4 + 5) = 9.

Next, we evaluate the next level: 9 • 2 = 18.

Then the next level: 18 + 4 = 22.

Finally, we evaluate the 'outside' parts of the equation:

22 ÷ 2 = 11.

MATHEMATICS ON THE JOB II
SESSION 7

Student Exercise:

Solve the following equations:

1. $5 \bullet (3 + 5) =$
2. $(5 + 5) \bullet 4 =$
3. $((5 + 3) \bullet 2) - 4 =$
4. $(2 \bullet 3 \bullet 5) - (4 \div 2) =$
5. $(4 \div 2) \bullet (4 + (5 - 2)) =$
6. $((5 + 3) \bullet 4) \div 8 =$
7. $(((12 \div 6) + 5) \bullet 2) - 3 =$
8. $((5 + 5 - 3) \bullet 2) - 5 =$
9. $((6 \div 2 \bullet 3) \div 3) + 2 =$
10. $7 + ((2 \bullet 6) - (8 \div 2)) =$

Step 3: Multiplication and Division

Step 3 in the order of operations is to evaluate the multiplication and division parts of the equation, working from left to right in the equation.

EXAMPLE: Solve $4 \cdot 6 \div 2 \cdot 3 =$

Working from left to right, we multiply $4 \cdot 6$ first:	$4 \cdot 6 = 24$.
Next, we divide our answer of 24 by 2:	$24 \div 2 = 12$.
Next, we multiply our answer by 3:	$12 \cdot 3 = 36$.

MATHEMATICS ON THE JOB II
SESSION 7

Student Exercise:

Solve the following equations:

1. $5 \cdot 3 \cdot 2 =$
2. $4 \cdot 3 \div 2 =$
3. $6 \div 3 \cdot 2 \cdot 4 =$
4. $(5 \cdot 3 \cdot 2) \div (4 \div 2) =$
5. $(4 \div 1) \cdot (5 \cdot 2) =$
6. $((5 \cdot 2) \cdot 4) \div 8 =$
7. $3 \cdot 4 \cdot 2 \div 4 =$
8. $(5 \cdot 5) \cdot (18 \div 6) =$
9. $((6 \div 2 \cdot 3) \div 9) \cdot 5 =$
10. $(7 \cdot 3 \cdot 4) \div 2 =$

Step 4: Addition and Subtraction

The final step in the order of operations is to perform all addition and subtraction, again working from left to right in the equation.

EXAMPLE: Solve $4 + 5 - 3 + 10 + 3$.

First, we add 4 and 5: $4 + 5 = 9$.

Next, we subtract from our current total: $9 - 3 = 6$.

Next add 10 to the current total: $6 + 10 = 16$

Finally, add three to the new total: $16 + 3 = 19$.

Student Exercise:

TRUE/FALSE — Examine each of the following equations. Mark each as true if the equation is solved using the correct order of operations, or false if the equation is not properly solved.

1. $5 \cdot 3 + 5 = 40$
2. $(5 + 5) \cdot 3 = 30$
3. $5 + 3 \cdot 2 - 3 = 13$
4. $2 \cdot 3 \cdot 4 - 4 \div 2 = 22$
5. $6 \div 2 \cdot 4 + (5 - 2) = 15$
6. $(5 + 3) \cdot 4 = 32$
7. $12 \div 6 + 5 \cdot 2 = 14$
8. $5 + 5 - 3 \cdot 2 = 14$
9. $6 \div 2 \cdot 3 \div 3 + 2 = 5$
10. $7 + 2 \cdot 3 - 8 \div 2 = 9$

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MATHEMATICS ON THE JOB II
SESSION 7

Student Exercise: Using the rules for order of operations, solve the following equations:

1. 5 + 5 • 5 ÷ 5 =

6. 2 + 12 • 8 + 5 − 10 ÷ 2 • 5 =

2. (5 + 3) • 2 + (10 ÷ 5) =

7. 6 • 6 + 6 ÷ 6 − 6 =

3. 18 ÷ 3 • 2 + 5 • 3 − 7 =

8. (4 • 5 + 2) • 2 ÷ 11 + 9 =

4. (18 ÷ 6 + 7 • 2) + 12 − 3 =

9. (6 + 3) • (12 − 3) =

5. ((5 + 7) ÷ 3 • 5) ÷ 4 + 9 =

10. 6 • 3 ÷ 2 + 5 − 3 • 4 =

OBJECTIVES

SESSION 8

- ✓ Understand and use formulas.
- ✓ Use formulas to solve job-related problems.

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MATHEMATICS ON THE JOB II
SESSION 8

USING FORMULAS

Definitions

Formula:

MATHEMATICS ON THE JOB II
SESSION 8

USING FORMULAS

What are formulas?

Formulas are commonly used equations which express a specific physical problem mathematically.

Formulas save time because the difficult part of solving an equation, namely writing and simplifying the algebraic expression, has already been done for you.. All you need to do is "plug" the information you already have into the existing formula and then solve it.

EXAMPLE: Find the area of a rectangle that has a length of 6 feet and a width of 4 feet.

To find the area of a rectangle, you would use the formula **area = length • width**, which can be written as A = lw.

In the problem, the length of the rectangle is 6 feet, and the width is 4 feet. Plugging these values into our formula, we get the following:

area = 6 • 4

Solving this equation, we find that the area of the rectangle is 24 square feet.

MATHEMATICS ON THE JOB II
SESSION 8

USING FORMULAS

Temperature Conversions Using Formulas

Performing temperature conversions is a good example of using formulas. The following are the formulas used for converting from fahrenheit to celsius:

To convert from fahrenheit to celsius: $°C = \frac{5}{9}(°F - 32)$

To convert from celsius to fahrenheit: $°F = \frac{9}{5}°C + 32$

Using these two formulas, we can easily convert celsius temperatures into fahrenheit temperatures, and fahrenheit temperatures into celsius temperatures.

MATHEMATICS ON THE JOB II
SESSION 8

USING FORMULAS

EXAMPLE: Convert 50° Fahrenheit to Celsius.

Using the formula: $°C = \frac{5}{9}(°F - 32)$

we then plug in the fahrenheit temperature we have:

$$°C = \frac{5}{9}(50 - 32)$$

Using order of operations, we can then solve this equation.

$°C = \frac{5}{9}(18)$ (Parentheses first)

$°C = \frac{5}{9} \times \frac{18}{1}$ (Convert 18 into an improper fraction)

$°C = \frac{90}{9}$ (multiply)

$°C = 90 \div 9$ (divide)

$°C = 10$ (final answer)

So, using one of the temperature conversion formulas, we see that 50 °F is equal to 10 °C.

MATHEMATICS ON THE JOB II
SESSION 8

USING FORMULAS

Exercise: Solve the following problems using the following formulas and information given in the problem. Include the formula you used as part of your answer.

Exercise Formulas:

To convert a temperature from fahrenheit to celsius: $°C = 5/9\,(°F - 32)$

To convert a temperature from celsius to fahrenheit: $°F = 9/5\,°C + 32$

To convert from miles to yards: $\text{miles} \cdot 1760 = \text{yards}$

To find the area of a rectangle: $\text{area} = \text{length} \cdot \text{width}$

To find the speed of a vehicle: $\text{speed} = \frac{\text{distance}}{\text{time}}$

Exercise Problems:

1. Convert 3 miles into yards:

   Answer: __________

2. How long will it take a car to cover 20 miles if the car is traveling at 60 miles per hour?

   Answer: __________

MATHEMATICS ON THE JOB II
SESSION 8

USING FORMULAS

Exercise Formulas:

To convert a temperature from fahrenheit to celsius: $^{\circ}C = 5/9\ (^{\circ}F - 32)$

To convert a temperature from celsius to fahrenheit: $^{\circ}F = 9/5\ ^{\circ}C + 32$

To convert from miles to yards: $\text{miles} \cdot 1760 = \text{yards}$

To find the area of a rectangle: $\text{area} = \text{length} \cdot \text{width}$

To find the speed of a vehicle: $\text{speed} = \frac{\text{distance}}{\text{time}}$

3. If the area of a rectangle is 60 square yards, and the width is 5 yards, what is the length of the rectangle?

Answer: ___________

4. Convert 212° Fahrenheit to Celsius.

Answer: ___________

5. How fast is a car going (in miles per hour) if it covers 165 miles in three hours?

Answer: ___________

6. Convert –40° Fahrenheit to Celsius.

Answer: ___________

MATHEMATICS ON THE JOB II
SESSION 8

USING FORMULAS

Exercise Formulas:

To convert a temperature from fahrenheit to celsius: °C = 5/9 (°F – 32)

To convert a temperature from celsius to fahrenheit: °F = 9/5 °C + 32

To convert from miles to yards: miles • 1760 = yards

To find the area of a rectangle: area = length • width

To find the speed of a vehicle: $\text{speed} = \dfrac{\text{distance}}{\text{time}}$

7. How many miles is 8800 yards?

Answer: __________

8. Convert 10° Celsius to Fahrenheit.

Answer: __________

9. Find the area of a rectangle with a width of 3 yards and a length of 7 yards.

Answer: __________

10. Convert 30° Celsius to Fahrenheit.

Answer: __________

MATHEMATICS ON THE JOB II
SESSION 8

USING FORMULAS

Solving Job-Related Word Problems with Formulas

Sample Word Problem

If, during their shift, a work team pulled 5 skids (each with 5 cartons), had 3 starting cartons and 2 ending cartons, and there were 54 pieces a carton, how many pieces did they produce during their shift?

If the team worked 48 man hours, but lost 8 man hours due to an equipment failure, how many pieces did they produce per man hour?

1. **Determine what the question is.**
   What is the answer(s) you are being asked to find?

   For this problem, we need to find out:

   - How many total pieces were produced by the team during their shift?
   - How many pieces per man hour?

2. **Identify the information you need to solve the problem.**
   Draw a sketch if possible to help visualize the problem.

   The facts needed to solve the problem are:

   - 5 skids pulled
   - Each skid has 5 cartons
   - 3 starting cartons
   - 2 ending cartons
   - 54 pieces per carton
   - 48 man hours worked
   - 8 man hours lost

USING FORMULAS

3. **Identify what mathematical formula or operations to use.** Write down the formula you will need to solve.

The formulas needed to solve the problem are listed in the box below:

Pieces per Shift = (Skids Pulled x Cartons per Skid x Pieces Per Carton) – (Starting Cartons x Pieces Per Carton) + (Ending Cartons x Pieces Per Carton)

Total Man Hours = Man Hours – Lost Man Hours

Pieces per Man Hour = Pieces Per Shift / Total Man Hours

4. **Simplify if possible, and perform the math to solve the problem.** Write down your answer and check your math.

Part 1: How many total pieces were produced by the team ?

To solve the first part of the problem (how many pieces were produced), we take the formula for Pieces per Shift and 'plug' in the values we already know:

Pieces per Shift = (Skids Pulled x Cartons per Skid x Pieces Per Carton) – (Starting Cartons x Pieces Per Carton) + (Ending Cartons x Pieces Per Carton)

Pieces per Shift = (5 x 5 x 54) – (3 x 54) + (2 x 54)

Pieces per Shift = (1350) – (162) + (108)

Pieces per Shift = 1296

USING FORMULAS

Step 4 (cont'd.)

Part 2: How many pieces were produced per man hour?

To solve the second part of the problem, we can use the formulas for Total Man Hours and the formula for Pieces per Man Hour:

Total Man Hours = Man Hours – Lost Man Hours

Pieces per Man Hour = Pieces Per Shift / Total Man Hours

Inserting (or "plugging in") the values from the original problem and the answer from part 1 (pieces per shift), we can now solve part 2:

Total Man Hours = 48 – 8 = 40

Pieces per Man Hour = 1296 / 40 = 32.4

5. **Ask yourself, "Is my answer reasonable?".**

Does a work team producing 1296 pieces in a shift sound correct? How about producing an average of 32.4 pieces per man hour? If these answers seem inaccurate, there may be a mistake in our calculations, or there we might be working with incorrect numbers. It may also help to check to make sure that we used the right formula.

MATHEMATICS ON THE JOB II
SESSION 8

USING FORMULAS

Word Problem Exercises

Using the 2-page form at the back of this session (labeled Worksheet A), complete the form for each of the five dates listed below, using the information provided. Find the Pieces per man hour using the following formulas:

Pieces per Shift = (Skids Pulled x Cartons per Skid x Pieces Per Carton) – (Starting Cartons x Pieces Per Carton) + (Ending Cartons x Pieces Per Carton)

Total Man Hours = Man Hours – Lost Man Hours

Pieces per Man Hour = Pieces Per Shift / Total Man Hours

1st day of the month:	A work team pulled 2 skids, had 2 starting cartons and 2 ending cartons. The team worked 50 man hours, but lost 2 man hours due to an equipment failure.
2nd day of the month:	The team pulled 1 skid, and had 1 starting carton. After the shift, they had 2 ending cartons. The team lost 1 hour off of the 46 man hours worked due to an equipment failure.
3rd day of the month:	The team worked a total of 43 hours, and lost no man hours. They pulled 2 skids, and had 6 starting cartons. They had 1 ending carton.
4th day of the month:	A work team pulled 2 skids, had 3 starting cartons and 1 ending carton. The team worked 58 man hours, but lost 2 man hours due to a bristler failure.
5th day of the month:	The team pulled 2 skids, and had 4 starting cartons. The team lost 2 hours of the 44 man hours worked due to a

WORKSHEET A

TOTAL PRODUCED	TOTAL MAN HRS.	DATE	PCS/MAN HR.
		1	
		2	
		3	
		4	
		5	
		6	
		7	
		8	
		9	
		10	
		11	
		12	
		13	
		14	
		15	
		16	
		17	
		18	
		19	
		20	
		21	
		22	
		23	
		24	
		25	
		26	
		27	
		28	
		29	
		30	
		31	

Part # EK 103-102 & 105
Description [illegible]
Month June
Shift 1st

Qty/Ctn 63
Ctn/Skid 24

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DATE	STARTING CTN	SKIDS PULLED	ENDING CTN	MAN HRS. LOST	REASON	COMP. BY
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
29						
30						
31						

OBJECTIVES

SESSION 9

- ✓ Understand and use the concepts of ratio and proportion.
- ✓ Demonstrate ability to solve ratio and proportion word problems.

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MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Definitions

Ratio

____

____

____

Proportion

____

____

____

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Ratios

A ratio is a comparison of two numbers by division. For example, suppose you produce 550 parts and 55 of those were defective. You could use a ratio to express the amount of defective parts compared to the total number of parts:

Number of defective parts to total number of parts: 55:550

A fraction can also be an example of a ratio:

* * o o o o

In the diagram above, there are two stars and four circles. The ratio between them would be 2 to 4, which could be written as the fraction 2/4. Written in lowest terms, the ratio of stars to circles would be 1/2, or 1 star for every two circles.

Ways to Express Ratios

There are several ways to express ratios:

Using a colon	Number of defective parts:Total number of parts 55:550
As a common fraction	$\frac{\text{Number of defective parts}}{\text{Total number of parts}}$ $\frac{55}{550}$ or $\frac{1}{10}$
As a decimal	$\frac{\text{Number of defective parts}}{\text{Total number of parts}}$ .1
As a percent	$\frac{\text{Number of defective parts}}{\text{Total number of parts}}$ 10%

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Ratios are very specific comparisons. You need to be careful when finding a ratio to make sure you're finding the correct ratio. Let's get back to our example:

You've produced 550 parts and 55 of those are defective. What are the following ratios?

Number of defective parts to Total number of parts ________

Number of defective parts to Number of good parts ________

Number of good parts to Total number of parts ________

Number of good parts to Number of defective parts ________

Ratios can be used to convert between different measuring systems. For example, 1 kilogram is equal to 2.2046 pounds. The ratio between kilograms and pounds is 1:2.2046. To convert from kilograms to pounds, all you need to do is to multiply the number of kilograms by 2.2046.

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Ratios Practice

Write each ratio with a colon.

1. 35 quarts of oil used in 3 hours. ______

2. 6 boxes packed to 25 boxes left to be packed. ______

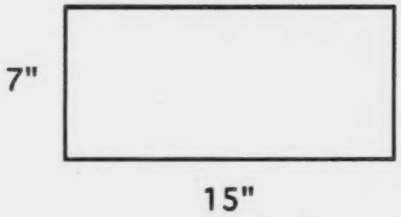
3. 5 inches in length to 2 inches in height. ______

4. 32 hours worked to 40 hours to work. ______

Express each ratio as a common fraction. Reduce to lowest terms.

5. Each day it takes 400 lbs. of raw material to produce 300 lbs. of finished product. What's the ratio of the weight of finished product to the weight of raw material? ______

6. When John first started working, he made $12.00 an hour. Now he makes $18.00 an hour. What's the ratio of his increase to what he makes now? ______



7. What's the ratio of length to height in the above rectangle? ______

RATIO AND PROPORTION

Ratios Practice (Cont'd.)

Express each ratio as a decimal.

8. Average weekly production is 22,500 brushrolls. Average daily production is 4500 brushrolls. What's the ratio of average daily production to average weekly production? ______

9. You've saved 5 minutes of time on a production process that normally took 120 minutes. What's the ratio of time saved to the time the process used to take? ______

What's the ratio of the amount of time the process now takes compared to the time the process used to take? ______

Express each ratio as a percent.

10. Out of 300 lbs. of raw material, 45 lbs. are scrapped. What's the ratio of lbs. of scrap to raw material? ______

11. You produced 2,800 brushrolls. 140 were defective. What's the ratio of defective parts to total number of brushrolls? ______

What's the ratio of defective parts to good parts? ______

RATIO AND PROPORTION

Units in Ratios

Usually, when we read or write a ratio, we just read or write the numbers. This is fine, as long as we're certain that the units of the 2 values we're comparing are the same.

For instance, if we're comparing pounds to pounds or hours to hours, it's okay to write down just the numbers. However, if the units are different, we need to write the *units* as well as the numbers as part of the ratio.

For instance, the ratio 12,000 valves produced in 8 hours, is:

$\frac{12{,}000}{8}$ valves/hour or 1,500 valves/hour

How would the ratio of 7 quarts of oil used in 3 hours be written? _______

It's important to make sure the size of the units are the same if the units express the same thing. For instance, in the ratio of 3 hours to 2 days, both units express time. However, they each express different amounts of time. In this case, you need to change one of the units to the same size of the other. Then, usually you can just cancel the units and express the ratio as a number only. But, be careful, before canceling units. Make sure they are the same size.

Example: $\frac{\text{Hours}}{\text{Day}} = \frac{3\text{ Hours}}{2 \times 24\text{ Hours}} = \frac{3}{48} = \frac{1}{16}$

How would you change the ratio $\frac{4\text{ quarts oil}}{7\text{ gallons oil}}$ in order to cancel the units?

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Ratio Units Practice

Write the following ratios. Be on the lookout for units you can cancel.

1. Downtime of 20 minutes in 8 hours. ________

2. A cost of $2,000 to rework 280 parts. ________

3. A weight of 750 lbs. to 2 tons. ________

Note: 1 ton = 2000 lbs.

4. 25 rejected parts produced in 2 hrs. ________

5. 2 days of vacation time taken in 2 weeks. ________

Note: 1 week = 5 workdays.

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

What is a proportion?

2 ratios that are equal are called a proportion. for instance, the ratio of 2 to 3 is equal to the ratio of 4 to 6, or mathematically,

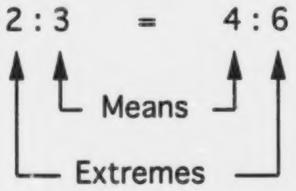
$$2:3 = 4:6$$

$$\frac{2}{3} = \frac{4}{6}$$

To determine if 2 ratios are equal, it's important to remember the following rule, stated in 2 ways:

1. In a proportion, the product of the means equals the product of the extremes.

   The means are the inside values.
   The extremes are the outside values.



2. In a proportion, the cross-products of the 2 ratios are equal.

   To find a cross-product, multiply the numerator of one fraction by the denominator of the other.

$$\frac{2}{3} = \frac{4}{6} \qquad 2 \times 6 = 12 \qquad 3 \times 4 = 12$$

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Practice

Are the following ratios equal?

1. 8:10 32:40

2. 50:2 25:3

3. 9/12 12/14

4. 6/10 30/50

5. 8/9 21/27

6. 3/48 9/96

7. 7/3 31/12

8. 80/12 240/36

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Ratio and Proportion Word Problems

You can use your knowledge of proportions to help you solve many problems. If you know 3 out of the 4 numbers in a proportion, it's easy to calculate the fourth number.

To find the missing number in a proportion:

7:28 = ___:84

First, multiply the means and the extremes, or cross-multiply.

28 x ___ = 588
Product of means Product of extremes

Next, divide by the number in front of the unknown number to find the answer.

$$\frac{28 \times \underline{\quad}}{28} = \frac{588}{28}$$

___ = 21

To check your answer, enter the number back in the proportion and multiply the means and the extremes or cross-multiply.

7:28 = 21:84

28 x 21 = 7 x 84

588 = 588

Exercise: What's the missing number in the following proportions?

4:7 = 20:__

$$\frac{8}{\underline{\quad}} = \frac{72}{108}$$

$$\frac{240}{48} = \frac{\underline{\quad}}{12}$$

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Ratio and Proportion Word Problems

Example

If it takes 8 hours to produce 1,200 brushrolls, how many hours will it take to produce 7,200 brushrolls?

Step 1. The question is:

Step 2. The necessary information is:

Step 3. Set up the proportion. Pay attention to the units:

Step 4. Solve the proportion:

Step 5. Is my answer reasonable?

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Ratio and Proportion Word Problems

Example

If it takes 8 hours to produce 1200 brushrolls, how many days will it take to produce 14,400 brushrolls?

Step 1. The question is:

Step 2. The necessary information is:

Step 3. Set up the proportion. Pay attention to the units:

Step 4. Solve the proportion:

Step 5. Is my answer reasonable?

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Ratio and Proportion Word Problems

Example

If your ratio of defective brushrolls to total parts is 6%, how many defective brushrolls can you expect out of a total of 1200?

Step 1. The question is:

Step 2. The necessary information is:

Step 3. Set up the proportion. Pay attention to the units:

Step 4. Solve the proportion:

Step 5. Is my answer reasonable?

RATIO AND PROPORTION

Student Exercises: Solve the following ratio and proportion word problems:

1. If 20 inches equals 508 millimeters, how many millimeters equals 2 inches?

2. If two gallons of paint can cover 212 square feet, how many gallons will be needed to cover 318 square feet?

3. One brushroll has a diameter of 3 inches and is 9 inches long. Another brushroll is 4 inches in diameter and is 12 inches long. Are the ratios between the brushrolls' diameters and lengths the same?

4. If 10 gallons of paint are required to paint 5,000 brushrolls, how many gallons of paint would be needed for 7,000 brushrolls?

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

5. It normally takes 15 hours to manufacture 3000 brushrolls. How many brushrolls could be produced in only 10 hours?

6. A worker can produce 18,000 brushrolls in 30 hours. What is the ratio of brushrolls to hours?

7. Five bristlers can process 900 brushrolls in four hours. How many brushrolls can they process in five hours?

8. 1200 brushrolls can be processed in one hour if there are five workers. How many brushrolls can be processed in one hour if there are six workers?

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
POST-ASSESSMENT

I. Add or subtract the following fractions. Reduce your answer to lowest terms. If the answer is an improper fraction, convert it to a mixed number.

A. 3/4 + 5/8 =

B. 1 7/8 – 49/64 =

II. Multiply or divide the following fractions. Reduce your answer to lowest terms. If the answer is an improper fraction, convert it to a mixed number.

A. 8/9 x 21/64 =

B. 5/8 ÷ 10/13 =

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
POST-ASSESSMENT

III. Insert either < or > in the space between each pair of numbers to make the statement correct.

A. $3 \quad -4$ B. $-6 \quad -8$

C. $5 \quad 6$ D. $7 \quad -7$

IV. A. What is $|54|$? ______________________________

B. What is $|-16|$? ______________________________

V. Add or subtract the following integers:

A. $-5 + 3 =$

B. $8 - (-6) =$

C. $9 + (-3) =$

VI. Multiply or divide the following integers:

A. $(-7)(10) =$

B. $(-4) \div (-2) =$

C. $(-2)(-3) =$

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
POST-ASSESSMENT

VII. Evaluate the following expressions:

A. $2 + [3 - (6 \times 2) + 12] =$

B. $2((3 + 4) \cdot 2) + 2 - 10 =$

C. $((2 + 6 \cdot 8 - 3) - 10) + 5 =$

D. $8 \cdot 2 + 7 + 9 / 3 - 3 \cdot 3 =$

VIII. Total each day's gauge readings on the following table and place the answer in the row marked "ΣX".

Day:	Mon	Tue	Wed	Thu	Fri
Reading 1	+.05	−.02	+.32	+.33	+.11
Reading 2	−.11	+.31	+.12	+.15	−.21
Reading 3	−.30	+.05	+.03	−.21	−.02
Reading 4	+.23	−.22	−.15	−.30	−.14
ΣX =					

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
POST-ASSESSMENT

IX. Solve the following percentage-related problems:

A. Production of brushes is averaging 1 defective brush out of every 270 made. What is the percentage of defective brushes out of the total produced?

B. A 12-inch brush must be within 99% of its proper length to pass inspection. How short can a brush be and still pass inspection?

C. Out of 50 rejected brushes, 7 were rejected because they were not properly locked in the bristler, 35 because they were caught in the trimmer, and 8 because the brushroll was smashed putting in bearings. What percentage were rejected because they got caught in the trimmer?

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
POST-ASSESSMENT

X. Solve the following ratio-related problems.

A. A machine normally can core 120 brushes in 2 hours. How many brushes can it produce in 3 hours?

B. A machine normally can drill 100 brushes in 1 hour. If the speed is increased by 50%, how many brushes can the machine process in 4 hours?

C. If seven workers can produce 322 brushes per hour, how many brushes could two workers produce an hour?

D. If Max can finish 344 brushes in a shift, how many brushes could he finish in half a week?

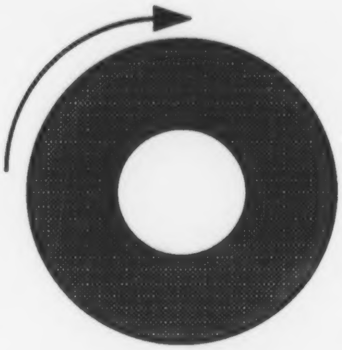
CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
POST-ASSESSMENT

XI. Solve the following problems.

For questions A and B, use the following formula:

Wheel Surface Speed =

Diameter of Wheel x 3.14 x Revolutions per Minute ÷ 12



A. If the diameter of the wheel is 10 inches and the RPM is 100 revolutions per minute, what is the wheel surface speed?

B. If the diameter of the wheel is 20 inches and the RPM is 160 revolutions per minute, what is the wheel surface speed?

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
POST-ASSESSMENT

For questions C and D, use the following formulas:

Pieces per Shift = (Skids Pulled x Cartons per Skid x Pieces Per Carton) – (Starting Cartons x Pieces Per Carton) + (Ending Cartons x Pieces Per Carton)

Total Man Hours = Man Hours – Lost Man Hours

Pieces per Man Hour = Pieces Per Shift / Total Man Hours

C. If, during their shift, Roger's team pulled 5 skids (each with 5 cartons), had 3 starting cartons and 2 ending cartons, and there were 54 pieces a carton, how many pieces did they produce during their shift?

D. Using the answer from question C, if Roger's team worked 48 man hours, but lost 8 man hours due to an equipment failure, how many pieces did they produce per man hour?

CWP

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Mathematics

on-the-job

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Facilitator Manual

II

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CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II

OBJECTIVES

Upon completion of the Mathematics on the Job II course, participants will be able to:

- ✔ state an increased comfort with math and express increased self-confidence with math skills
- ✔ demonstrate ability to work with fractions, decimals, and percents
- ✔ convert between fractions, decimals, and percents
- ✔ solve word problems involving fractions, decimals, and percents
- ✔ understand and use a number line
- ✔ perform the basic operations of addition, subtraction, multiplication, and division of positive and negative integers
- ✔ understand and apply rules of order of operations to solve equations
- ✔ use formulas to solve job-related problems
- ✔ demonstrate skills in solving job-related ratio and proportion problems

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
PRE-ASSESSMENT

I. Add or subtract the following fractions. Reduce your answer to lowest terms. If the answer is an improper fraction, convert it to a mixed number.

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CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
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C. $(-2)\;(-3) =$

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
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CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
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CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
PRE-ASSESSMENT

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CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
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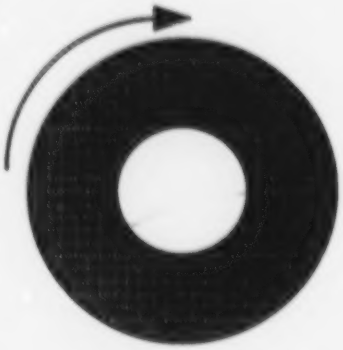

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MATHEMATICS ON THE JOB II
PRE-ASSESSMENT

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CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II

OBJECTIVES

SESSION 1

- ✓ State an increased comfort with math and express increased self-confidence with math skills.

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MATHEMATICS ON THE JOB II
SESSION 1

How to Study Math

Instructor's Outline

Introduction Introduce self and course. Have students introduce themselves. Pass out any books or materials needed.

Why are we here? (Ask students what they hope to get out of the course.)

Here's what we hope to provide:

- ✔ An opportunity for you to learn/review math skills necessary to effectively perform your job.
- ✔ An increased understanding of how important math is to your job, and to our technological society.
- ✔ The training and practice necessary to help you feel more comfortable with math and to increase your self-confidence with your math skills.

Exercise Have each student write down a personal math goal for himself or herself. They can choose from those above or write their own. This is not to be collected or shared with the class--it's for the student's personal use.

MATHEMATICS ON THE JOB II
SESSION 1

The Importance of a Positive Attitude

We've all heard the term "Math Anxiety" and many of us think it applies to us. What are some reasons why people are "afraid" of math? (List responses of class on board.)

Some Reasons for Math Anxiety

✔ **Past Conditioning** - we were told that we weren't good at math or we were "tracked" in high school and assumed we didn't need or couldn't learn math.

✔ **Can't see the need for math** - Often when we're younger, we don't realize or fail to see the importance of math to our future or our daily work lives. Now that we have jobs that require us to use math, it becomes much more relevant.

✔ **We believe myths about math**

1. Math is hard and complicated to learn

Math is different from learning vocabulary or how to read a blueprint. But math isn't as mysterious or complicated as we may have been led to believe. Everyone in this room has the ability to learn math.

2. Math is for eggheads.

Everyone needs and can learn math. And you don't necessarily have to have a "mathematical mind" to understand math. Sure, the eggheads may need and use theory more, but math skills and reasoning are useful and learnable by people at many different levels.

✔ **Not enough experience using math**

Maybe until now or recently, you never had much need for math. so, you probably don't have a lot of math experience. This class, will, of course, provide experience. And as you practice math skills, you'll feel more comfortable with your math abilities.

The Importance of a Positive Attitude (cont'd)

Whatever the reasons for your math anxiety, it's time to change and replace those old attitudes with a new positive attitude toward math.

"I know I can!" is the new attitude we want to develop.

What can I do to get and keep a positive attitude?

- ✔ **Believe in yourself.**

- ✔ **Tell yourself you know you can do it!**

  You can use affirmations/positive statements to help you in this area. Come up with a positive statement about your ability to learn math. Repeat this to yourself several times daily. Also, whenever negative thinking creeps in, stop, and replace those negative thoughts with your new positive statement.

- ✔ **Stay relaxed.**

  If you find yourself getting frustrated, take a break,mental or physical, for a few minutes. Then approach the problem or concept again.

- ✔ **Get rid of "all-or-nothing," have-to-be-perfect attitudes.**

  Yes, the right answer is important in math, but you're learning. So, give yourself credit for what you do right!

Having a positive attitude does not mean that math will come instantly or easily. You still may struggle and run into difficulties, but if you keep your positive attitude, you can persevere and you'll win in the end!

Exercise Have each student write a positive 1-sentence affirmation about their ability to learn math. This is what they should repeat to themselves daily and when they have difficulties.

Example: I know I have the ability to solve math problems.

MATHEMATICS ON THE JOB II
SESSION 1

What to Expect

✔ **Math is a process.**

Much like learning to run a machine. Did you go on the job and operate the machine like a pro the first time you ran it? Probably not. It took time, practice and experience before you became an expert. Math is very much the same. You'll need to work a lot of problems before you'll be an expert. but you will be one!

✔ **Math is learned by doing, not just observing.**

What if you read every book about bicycle riding there was? what if you subscribed to every bicycle magazine published, but you never got on a bike? Do you think you would know how to ride it? Of course not! You would know an awfully lot about how to ride one, but you, yourself, wouldn't be able to actually do it. Math is similar to bike-riding. You can watch the instructor work problems, you can follow each step along the way, but you won't learn math until you actually work the problems yourself.

In this class, there will be lots of opportunities to practice working problems. If you need more practice, there are software programs available in the learning lab and extra problem sets can be obtained from the instructor. Practice as much as you need to, not as little as you can get away with. In the case of math--Practice make Improvement!

What to Expect (cont'd)

✔ **Everyone learns math at different rates and approaches problems a little differently.**

It's good to interact with others, in fact, it's encouraged in this class. But don't compare yourself unfavorably to others, thinking that you're "slow" if you don't come up with the answer as quickly (perhaps you're just more thorough) or that you're "wrong" because your approach to a problem is a little different. Remember, everyone has his or her own way of doing things.

What's Expected

To succeed in math, you'll need to do the following:

✔ **Attend classes.**

Missing a class automatically puts you behind since math builds on skills. If you have to miss a class, contact the instructor. He or she can fill you in on what you'll be missing, and direct you to appropriate exercises and software to help you catch up quickly.

✔ **Participate in class.**

Ask questions when you're lost. (Chances are if you're lost, so are others.)

Actively participate in class and team activities. They're meant to be fun way to practice and improve skills.

Complete in-class assignments. Use the time given to work the math problems assigned. Since the instructor's there, if you run into problems, you can easily ask for help.

What's Expected (cont'd)

- ✓ **Listen actively and take effective notes.**

  Try to follow what the instructor's saying even if you can't make sense of it all, right away. (And don't be shy about asking questions.)

  Take neat, meaningful notes. This will help you to make sense of what was discussed later on.

  Listening and notetaking will be covered in more detail later.

- ✓ **Practice, practice, practice.**

  As mentioned earlier, this is the best way to learn math.

Class Discussion

What are student's expectations? What do they think of what's expected of them?

MATHEMATICS ON THE JOB II
SESSION 1

Math Notetaking and Study Tips

Notetaking Tips

Tip # 1: **Be neat.**

In math, neatness counts!! You need to be able to follow the problem-solving process, both in your notes and when working problems.

Tip # 2: **Write down the problem as the instructor works it out on the board and write down your explanation of the steps in the process.**

This will help you to understand the process and your notes will be a lot more useful because they won't just be a bunch of numbers.

Example

Adding a Positive and a Negative Number

Problem	Process
142 +(-) 14 ——— 128	1. Find the difference between the # with the larger absolute value and the # with the smaller absolute value. 2. Put the sign of the # with the larger absolute value in front of the answer.

Tip # 3: **Copy down all definitions and principles.**

It's important that you know and understand these. They'll be used over and over again in class and for explanations.

Math Notetaking and Study Tips (cont'd)

Tips for Reviewing Your Notes

Tip # 4: Rework the example problems.

Before you go on to the uncharted territory of practice problems, be sure you can work the known territory of the example problems in your notes. If you get stuck on the example problem, you can ask the instructor for clarification. This will save you time and frustration when you're out there on your own with the practice problems.

Tip # 5: Make sure you can explain the process for working different types of problems.

Explain it out loud, to yourself, to someone else, to your cat

and/or

Write down a process to follow when working out problems of a certain type. Pretend you're explaining to someone who doesn't know it.

Tip # 6: Work all practice problems as completely as you can.

Don't stop if you get a wrong answer to one of them and aren't sure where you went wrong, or if you notice the problems are getting more difficult. If you've gone over a problem several times and can't pinpoint your error, mark it and go on to the next one. Then come back to it. Or make a note to ask the instructor about it in the next class. When receiving an explanation, make sure you understand what the error was so you can avoid it in the future.

MATHEMATICS ON THE JOB II
SESSION 1

Solving Math Problems

Below is a general procedure to follow when solving problems.

1. **Don't be afraid of the problem** (especially if it looks complicated). Go ahead, give it your best shot. Even if you don't get the right answer, you'll learn a lot about the math process.

2. **Examine or read the problem carefully.** Determine what you're given and what you're supposed to find.

3. **Refer to your process for solving the type of problem you're working on.** Follow the process, step by step. Be sure to be neat.

4. **Recheck your work.** (Neatness makes this easier.) Many students skip this step, but those that recheck learn more (they see where they make their mistakes) and gain confidence more quickly (they take the opportunity to learn from and correct their mistakes.)

5. **Ask yourself is the answer is reasonable.** Does it make sense, given the information you had to work with? Or does is seem way off? If it doesn't seem right, go back to Step 4, one more time.

Remember: You have the ability to learn and solve math problems. If you use the tips and techniques given in this module, you'll be on your way to math success.

OBJECTIVES

SESSION 2

- ✓ Demonstrate ability to work with fractions.
- ✓ Demonstrate ability to solve word problems involving fractions.

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Definitions

Denominator	The part of a fraction below the line. $\dfrac{4}{16} \longleftarrow$ Denominator
Fraction	A Fraction is a number whose value is between 0 and 1. A fraction tells you that a whole number has been divided into two or more equal parts, and the fraction represents a certain number of those parts.
Greatest Common Factor	The Greatest Common Factor is the largest number which will divide evenly into both the numerator and the denominator of a fraction. Used to reduce a fraction to its lowest term.
Least Common Denominator	When adding or subtracting two or more fractions, the Least Common Denominator is the smallest number that's divisible by all of the denominators in the problem.
Numerator	The part of a fraction above the line. $\dfrac{4}{16} \longleftarrow$ Numerator

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Reducing Fractions to Lowest Terms

When you're working with fractions, you'll find it easier to solve problems if you convert the fractions to lowest terms. This way you'll avoid working with numbers that are large or cumbersome.

Reducing a fraction to lowest terms means that there is no number other than 1 that will divide evenly into both the numerator and the denominator.

Follow these steps to reduce a fraction to lowest terms:

1. Determine the largest number which will divide evenly into both the numerator and the denominator. This is called the Greatest Common Factor.
2. Divide both the numerator and the denominator by the greatest common factor.

Example: 18/66

1. 6 is the GCF (Greatest Common Factor) of 18 and 66
2. $$\frac{18}{66}\begin{matrix}\div\\\div\end{matrix}\frac{6}{6}\begin{matrix}=\\=\end{matrix}\frac{3}{11}$$

FRACTIONS REVIEW

Finding the Greatest Common Factor

Sometimes, finding the greatest common factor of 2 numbers is not so easy. So, here's a method that will help you to always find the greatest common factor:

1. Write the numerator and the denominator as the product of primes. A prime number is one which can only be divided by itself and 1.
2. Make a list of the primes common to both the numerator and the denominator.
3. Multiply the primes you listed in Step 2 together to figure out the greatest common factor.

Examples:

Find the greatest common factor of the numerator and the denominator in the fraction 125/600.

1. 125 = 5 x 5 x 5

   600 = 2 x 2 x 2 x 3 x 5 x 5

2. Two 5's are present in both numbers.

3. 5 x 5 = 25

   25 is the GCF of 125 and 600.

MATHEMATICS ON THE JOB II
SESSION 2

Find the greatest common factor of the numerator and the denominator in the fraction 420/1320

1. 420 = 2 x 2 x 3 x 5 x 7

   1320 = 2 x 2 x 2 x 3 x 5 x 11

2. Two 2's, one 3 and one 5 are present in both numbers.

3. 2 x 2 x 3 x 5 = 60

   60 is the GCF of 420 and 1320

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Adding and Subtracting Fractions with Like Denominators

To add or subtract fractions with like denominators:

1. Add or subtract the numerators.
2. Put the sum or difference over the common denominator.
3. If necessary, reduce the answer to lowest terms.

Examples:

$\frac{7}{10} - \frac{3}{10} = \frac{4}{10}$ Reduce: $\frac{4 \div 2}{10 \div 2} = \frac{2}{5}$

$\frac{5}{12} + \frac{4}{12} = \frac{9}{12}$ Reduce: $\frac{9 \div 3}{12 \div 3} = \frac{3}{4}$

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Adding and Subtracting Fractions with Unlike Denominators

Before we can add or subtract fractions that have unlike denominators, we must first convert them to fractions with the same denominator. The easiest way to keep the numbers from getting complicated is to use the lowest common denominator, or the smallest number that's divisible by each of the 2 denominators.

To find the LCD (Lowest Common Denominator):

1. Write each denominator as the product of primes.
2. Determine the maximum amount of times each prime appears in each denominator.
3. Multiply the primes together, only the maximum amount of times each appears in either of the 2 denominators. In other words, do not repeat multiplication of a prime the maximum number of times, if it appears in both denominators.

Examples:

Find the lowest common denominator for the fractions, 5/16 and 9/60.

1. $16 = 2 \times 2 \times 2 \times 2$
   $60 = 2 \times 2 \times 3 \times 5$
2. 2 appears 4 times.
   3 appears 1 time.
   5 appears 1 time.
3. Multiply $2 \times 2 \times 2 \times 2 \times 3 \times 5$ together.

   $2 \times 2 \times 2 \times 2 \times 3 \times 5 = 240$
   240 is the LCD of 16 and 60

NOTE: The two 2's appearing in the product of primes of 60 are not repeated for the multiplication in Step 3.

FRACTIONS REVIEW

Adding and Subtracting Fractions with Unlike Denominators

Finding the Lowest Common Denominator

Examples:

Find the lowest common denominator for the fractions, 6/49 and 120/126.

1. 49 = 7 x 7

   126 = 2 x 3 x 3 x 7

2. 2 appears 1 time.
   3 appears 2 times.
   7 appears 2 times.

3. Multiply 2 x 3 x 3 x 7 x 7 together.

   2 x 3 x 3 x 7 x 7 = 882
   882 is the LCD of 49 and 126

NOTE: The one 7 appearing in the product of primes of 126 is not repeated for the multiplication in Step 3.

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Adding and Subtracting Fractions with Unlike Denominators

Once you've found the lowest common denominator for 2 fractions, it's a lot easier to add or subtract them. To add or subtract fractions with unlike denominators:

1. Find the lowest common denominator.
2. Convert each fraction to an equivalent fraction with the lowest common denominator found in Step 1. After you convert, each fraction should have the same denominator.
3. Add or subtract the numerators.
4. Put the sum or difference over the lowest common denominator.
5. If necessary, reduce the fraction to lowest terms.

Examples:

5/16 + 9/60

1. We've already determined the LCD is 240.
2. 5/16 needs to be converted to an equivalent fraction whose denominator is 240.

   Since 240 ÷ 16 is 15, you'll need to multiply both the numerator and the denominator by 15.

$$\frac{5}{16} \times \frac{15}{15} = \frac{75}{240}$$

   9/60 needs to be converted to an equivalent fraction whose denominator is 240.

FRACTIONS REVIEW

Adding and Subtracting Fractions with Unlike Denominators

Since 240 ÷ 60 is 4, you'll need to multiply both the numerator and denominator by 4.

$$\frac{9}{60} \times \frac{4}{4} = \frac{36}{240}$$

3 & 4.

$$\frac{75}{240} + \frac{36}{240} = \frac{111}{240}$$

5. 111/240 can be reduced to 37/80.

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW Adding and Subtracting Fractions with Unlike Denominators

Examples: 6/49 + 120/126

1. We've already determined the LCD is 882.

2. 6/49 needs to be converted to an equivalent fraction whose denominator is 882

   Since 882 ÷ 49 is 18, you'll need to multiply both the numerator and the denominator by 18.

$$\frac{6}{49} \times \frac{18}{18} = \frac{108}{882}$$

   120/126 needs to be converted to an equivalent fraction whose denominator is 882.

   Since 882 ÷ 126 is 7, you'll need to multiply both the numerator and denominator by 7.

$$\frac{120}{126} \times \frac{7}{7} = \frac{840}{882}$$

3 & 4. 108/882 + 840/882 = 948/882

5. 948/882 = 158/147 or 1 11/147

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Practice

Add or subtract the following fractions. Be sure to reduce the answers to lowest terms.

5/16 - 3/16 = **1/8**

65/72 - 3/8 = **19/36**

1/8 + 5/8 = **3/4**

5/32 + 7/60 = **131/480**

19/80 + 3/50 = **119/400**

9/10 + 3/12 = **23/20**

8/9 + 7/21 + 6/81 = **35/27**

9/32 - 1/16 = **7/32**

3/16 + 7/16 = **5/8**

56/90 - 5/8 = **-1/360**

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Multiplying Fractions

To multiply fractions together:

1. Multiply the numerators.
2. Multiply the denominators.
3. Put the product of the numerators over the product of the denominators.
4. If necessary, reduce the answer to lowest terms.

HINT: In multiplication, you can cancel out common factors in the numerators and denominators before you multiply. This will often help you avoid having to reduce the answer to lowest terms, or get your answer a lot closer to being in lowest terms.

Examples:

5/6 x 7/8 = 35/48

35/48 is in lowest terms.

3/16 x 4/9

In this problem, we can cancel as follows:

3/16 x 4/9 = 1/12

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Dividing Fractions

To divide fractions:

1. Invert the divisor (typically, the number after the ÷ sign) and replace the division sign with a multiplication sign.
2. Multiply the numerators.
3. Multiply the denominators.
4. Put the product of the numerators over the product of the denominators.
5. If necessary, reduce the answer to lowest terms.

HINT: In multiplication, you can cancel out common factors in the numerators and denominators before you multiply. This will often help you avoid having to reduce the answer to lowest terms, or get your answer a lot closer to being in lowest terms.

Examples:

$$\frac{6}{7} \div \frac{4}{5} = \frac{6}{7} \times \frac{5}{4} = \frac{30}{28}$$

$$\frac{30 \div 2}{28 \div 2} = \frac{15}{14}$$

(or 1 1/14)

$$\frac{3}{16} \div \frac{4}{9} = \frac{3}{16} \times \frac{9}{4} = \frac{27}{64}$$

27/64 is in lowest terms..

FRACTIONS REVIEW

Converting Improper Fractions to Mixed Numbers

Usually you'll be asked to convert improper fractions (those where the numerator is greater than the denominator) to mixed numbers. Follow these steps:

1. Divide the numerator by the denominator to determine the whole number portion of the mixed number.
2. Put the numerator over the denominator to express the fraction portion of the mixed number.
3. If necessary, reduce the fraction part to lowest terms.
4. Write the mixed number as the whole number and reduced fraction.

Examples: Convert 11/9 to a mixed number.

1. $$\begin{array}{r} 1 \\ 9\,\overline{)\,11} \\ \underline{9} \\ 2 \end{array}$$ 1 is the whole number position.

2. $\frac{2}{9}$ is the fraction portion.

3. $\frac{2}{9}$ cannot be reduced.

4. $\frac{11}{9} = 1\frac{2}{9}$

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW Converting Improper Fractions to Mixed Numbers

Examples: Convert 420/16 to a mixed number.

1. $$\begin{array}{r} 26 \\ 16\,\overline{)\,420} \\ \underline{32} \\ 100 \\ \underline{96} \\ 4 \end{array}$$ 26 is the whole number portion.

2. $\frac{4}{16}$ is the fraction portion.

3. $\frac{4}{16} \begin{matrix}\div \\ \div\end{matrix} \frac{4}{4} \begin{matrix}= \\ =\end{matrix} \frac{1}{4}$

4. $\frac{420}{16} = 26\frac{1}{4}$

FRACTIONS REVIEW

Converting Mixed Numbers to Improper Fractions

Often, when you are adding, subtracting, multiplying or dividing fractions, you'll need to convert mixed numbers to improper fractions. Here's how:

1. Multiply the denominator of the fraction times the whole number.
2. Add the product of the denominator and the whole number to the numerator.
3. Put the sum found in Step 2 over the denominator. This is the improper fraction. The numerator should be larger than the denominator.

Examples:

Express 1 2/15 as an improper fraction.

1. 1 2/15 15 x 1 = 15
2. 15 + 2 = 17
3. 17/15 is the improper fraction.

Express 16 2/3 as an improper fraction.

1. 16 2/3 3 x 16 = 48
2. 48 + 2 = 50
3. 50/3 is the improper fraction.

MATHEMATICS ON THE JOB II
SESSION 2

FRACTIONS REVIEW

Practice

Multiply the following fractions (Be sure to reduce your answer to lowest terms):

9/10 x 1/2 = **9/20**

7/8 x 4/5 = **7/10**

3/8 x 4 1/9 = **1 13/24**

1 1/7 x 4/5 x 2 1/2 = **2 2/7**

Divide the following fractions (Be sure to reduce your answer to lowest terms):

7/16 ÷ 3/4 = **7/12**

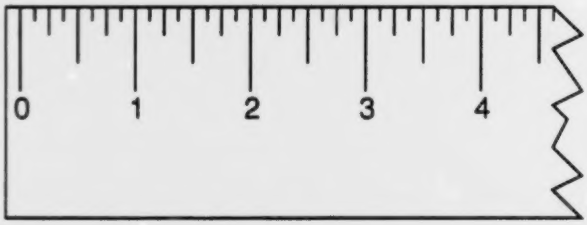
6/33 ÷ 4/11 = **1/2**

1/6 ÷ 8 2/9 = **3/148**

5/7 ÷ 49/60 = **300/343**

Reading Rulers

Rulers are measuring tools that divide large units into fractional parts. Look at the ruler below. Notice that there are numbered sections on the ruler below, representing inches. Each of those inches is further divided into halves (the next tallest lines), then quarters (the next tallest), and finally eights of an inch. If an object you were measuring had one end on the '0' inch mark, and the other end fell halfway between the one and two inch marks, it would be 1 1/2 inches long.

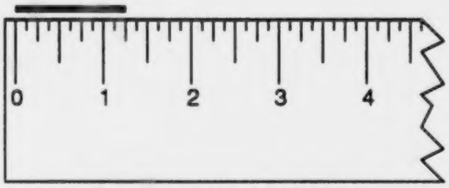


Most rulers divide the inches with lines of different lengths—each of the different line lengths represents a different fractional unit, such as quarter inches or eights of an inch. On the ruler above, the longest lines represent inches, the next tallest show half inches, the next tallest quarter inches, and the smallest are eighths of an inch. Some rulers divide inches even further, into sixteenths (1/16) and even thirty-seconds (1/32) of an inch.

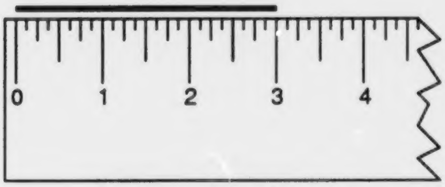
Adding different measurements uses the same rules as for adding fractions. To add 7/8 inches and 1 3/4 inches, for example, you would use the same process used to add two fractions.

MATHEMATICS ON THE JOB II
SESSION 2

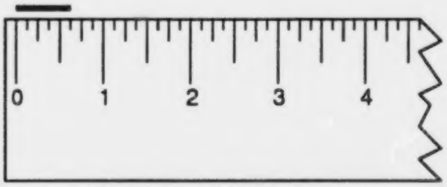
Exercise What is the length of the line shown above each ruler?



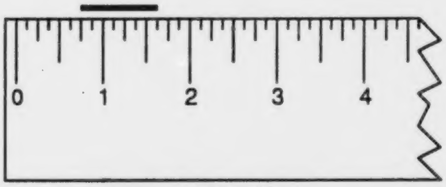
Answer: 1 1/4 inches



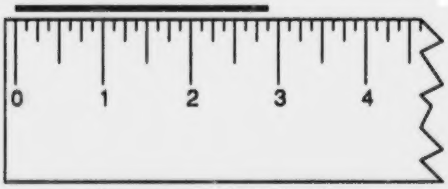
Answer: 3 inches



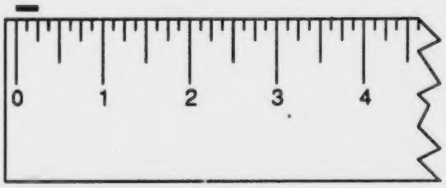
Answer: 5/8 inch



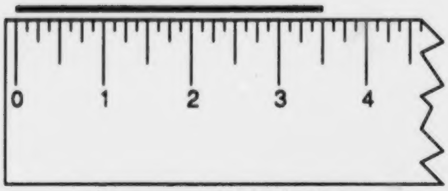
Answer: 7/8 inch



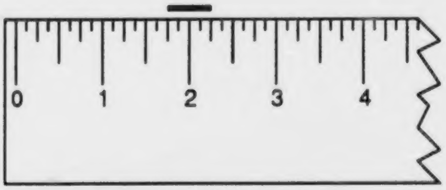
Answer: 2 7/8 inches



Answer: 1/4 inch



Answer: 3 1/2 inches



Answer: 1/2 inch

OBJECTIVES

SESSION 3

- ✓ Demonstrate ability to work with decimals.
- ✓ Demonstrate ability to solve word problems involving decimals.

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MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Definitions

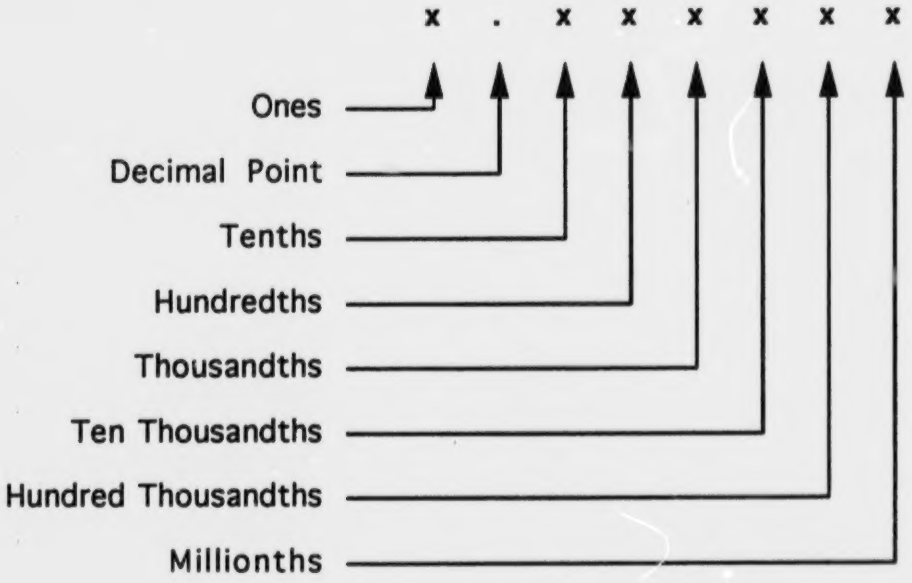
Decimal	A fraction that has a denominator that is a multiple of 10. Fractions are written in a special format, with the whole number followed by a decimal point (.), and the denominator indicated by place value after the decimal point.
Decimal Point	The decimal point is the period (.) that separates the whole number portion of a decimal from the fractional part.
Rounding	A method of simplifying numbers when the exact number is not necessary. For example, if you were calculating the average number of pieces produced per man hour, 755 would be easier to work with than 755.349647, and would still be accurate enough for any necessary calculations.

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Decimals Definition

A decimal is a fraction that has a denominator that is a multiple of 10. However, in writing decimals, the denominator is indicated by place value. The place values of numerals to the left of the decimal point are shown below:


x . x x x x x x
Ones
Decimal Point
Tenths
Hundredths
Thousandths
Ten Thousandths
Hundred Thousandths
Millionths

Exercise: What are the values of the following decimals?

.4 ____________________

.04 ____________________

.004 ____________________

.004 ____________________

.0004 ____________________

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Adding and Subtracting Decimals

Examples

$$\begin{array}{r} 4.27 \\ .0812 \\ 33.69 \\ +\ 5.1 \\ \hline 43.1412 \end{array}$$

$$\begin{array}{r} 48.734 \\ -\ 5.960 \\ \hline 42.774 \end{array}$$

$$\begin{array}{r} 7.18 \\ -\ 4.235 \\ \hline 2.945 \end{array}$$

Process

1. Arrange numbers in columns so that the decimal points line up.

2. Add or subtract the numbers as if the decimal points were not there.

   Hint: If there are blanks to the right of some numbers, treat the blanks as zeros. It may even help you to put zeros in place of the blanks, especially in subtraction.

3. Bring down the decimal point in the correct column.

Instructor Note: You may want to show the TPC math video "Decimals" either before or after the next section, 'Rounding Decimals in Addition and Subtraction Problems.' It will help to explain why we round decimal numbers the way we teach them. You may also want to point out that this is the scientific or engineering method of rounding, often used for the most accuracy on blueprints and other part specifications.

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Rounding Decimals in Addition and Subtraction Problems

If you need to round off an addition or subtraction answer, round it off to the same number of decimal places as the number in the problem with the least number of decimal places.

To figure out which way to round the digit:

If the numbers being dropped are:	Then:
1. Less than 5000	1. Keep the digit the same.
2. 5000 or greater	2. Increase the digit by 1.

Examples

$$\begin{array}{r} 4.17 \\ .0812 \\ 33.69 \\ +\ 5.1 \\ \hline 43.0412 \end{array}$$

Rounds to 43.0 (one decimal place because the number with the least number of decimal places is 5.1, with only one decimal place.)

$$\begin{array}{r} 48.734 \\ -\ 5.96 \\ \hline 42.774 \end{array}$$

Rounds to 42.77 (two decimal places because 5.96 has only two decimal places.)

$$\begin{array}{r} 7.18 \\ -\ 4.235 \\ \hline 2.945 \end{array}$$

Rounds to 2.95 (two decimal places because 7.18 only has two decimal places.)

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Exercise: Solve the following problems.

1. 1.375 + .08 + 36.15 = **37.605**

2. 42.1438 + 129.653 + 56.781 = **228.5778**

3. .4912 + .017 + .53 = **1.0382**

4. 2.798 + 35.2 + 4.674 = **42.672**

5. 56.872 – 14.02 = **42.852**

6. 425.68 – 45.926 = **379.754**

7. .37915 – .0150 = **.36415**

8. 2.78315 – .6543 = **2.12885**

9. 3.4589 + 5.382 = **8.841 (8.8409 before rounding)**
   (Round your answer)

10. 37.5299 + 28.75 = **66.28 (66.2799 before rounding)**
    (Round your answer)

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Multiplying Decimals

Example

$$\begin{array}{r} 2.65 \\ \times\ 3.3 \\ \hline 795 \\ 795 \\ \hline 8.745 \end{array}$$

$$\begin{array}{r} .014 \\ \times\ .51 \\ \hline 014 \\ 070 \\ \hline .00714 \end{array}$$

Process

1. Multiply the numbers first as if there were no decimal points.
2. Count the number of decimal places in the top number.
3. Count the number of decimal places in the bottom number.
4. Add the number of decimal places in the two numbers together.
5. Starting from the right, count over the same number of digits as the total number of decimal places in the numbers in the problem. Place your decimal point to the left of the digit.

   Note: If there are not enough digits, you'll need to add 0's to the left of the number.

Notes:

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Rounding Decimals in Multiplication Problems

If you need to round off a multiplication answer, round it off to the same number of digits as the number in the problem with the least number of digits. Your answer must have no more digits than the number in the problem with the fewest digits. This is different than rounding off after adding or subtracting.

To figure out which way to round the digit:

If the numbers being dropped are:	Then:
1. Less than 5000	1. Keep the digit the same.
2. 5000 or greater	2. Increase the digit by 1.

Examples

2.65	(three digits)
x 3.3	(two digits)
795	
795	
8.745	**Rounds to 8.7** (two digits because the number in the problem with the least number of digits is 3.3, with two digits.)

.014	(two digits)
x .51	(two digits)
014	
070	
.00714	**Rounds to .0071*** (two digits because the number in the problem with the least number of digits is .51, which has two digits.)

*Zeros don't get counted!

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Dividing Decimals

Examples

```
              9.7
     2.14 ) 20.758
           - 19 26
              1 498
            - 1 498
                  0
```

```
              2.037
     4.22 ) 8.60000
            - 8 44
               160
               - 0
               1600
             - 1266
               3340
             - 2954
                386
```

Process

1. Eliminate the decimal point in the divisor by moving it the required number of places to make it a whole number.

2. Move the decimal point in the dividend the same number of decimal places as you did for the divisor. (You're not trying to make this a whole number.)

   Note: If there are not enough places, you may need to add digits to the right of the dividend.

3. Divide as you would if there were no decimal points. Be sure to keep your numbers lined up.

4. Place the decimal point in the quotient directly above the <u>moved</u> decimal point in the dividend. This should be easy if your digits are lined up properly.

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Rounding Decimals in Division Problems

Rounding off a division answer works the same way as rounding off a multiplication answer. Round the number off to the same number of digits as the number in the problem with the least number of digits. Your answer should have no more digits than the number in the problem with the fewest digits.

To figure out which way to round the digit:

If the numbers being dropped are:	Then:
1. Less than 5000	1. Keep the digit the same.
2. 5000 or greater	2. Increase the digit by 1.

Examples

```
          9.7
2.14 ) 20.758
      - 19 26
         1 498
       - 1 498
             0
```

Rounds to 9.70 (three digits because the number in the problem with the fewest number of digits is 2.14, with three digits.)

```
         2.037
4.22 ) 8.60000
       - 8 44
          160
          - 0
          1600
        - 1266
          3340
        - 2954
           386
```

Rounds to 2.0 (two digits because the number in the problem with the fewest number of digits is 8.60000*, which only has two digits.

* Zeros don't get counted!

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Multiplying and Dividing Decimals
Practice

Note: Please tell students to round their division answers to 2 or 3 decimal places. However, for the answer key, the full answer is provided.

1. .375 x 2.9 = **1.0875**

2. 22.450 x .56 = **12.572**

3. 77.35 x 2.5 = **193.375**

4. .4187 x .358 = **.1498946**

5. 36 ÷ .47 = **76.595744**

6. 6.2812 ÷ 2.3 = **2.7309565**

7. 127.91 ÷ 3.36 = **38.068452**

8. 4.9 ÷ .715 = **6.8531468**

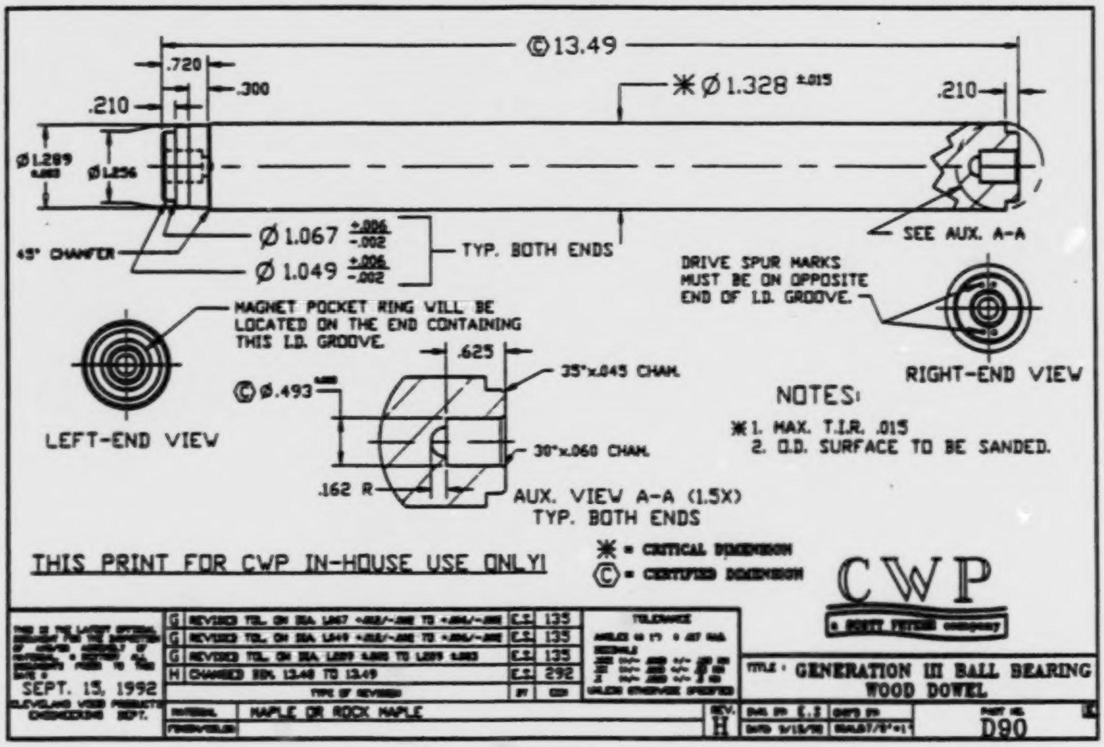
MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Solving Word Problems Involving Decimals

Sample Word Problem

Using the blueprint below, George must find the maximum and minimum acceptable diameter measurements for a Generation III ball bearing wood dowel. Looking at the blueprint, he sees that the desired diameter is 1.328 inches, plus or minus (±) .015 inches. Using this information, what are the maximum and minimum diameters which are still acceptable for this model of wood dowel?



©13.49
.720
.300
.210
✳ Ø 1.328 ±.015
.210
Ø1.289
Ø1.256
Ø 1.067 +.006 -.002
Ø 1.049 +.006 -.002
TYP. BOTH ENDS
45° CHAMFER
SEE AUX. A-A
DRIVE SPUR MARKS MUST BE ON OPPOSITE END OF I.D. GROOVE.
MAGNET POCKET RING WILL BE LOCATED ON THE END CONTAINING THIS I.D. GROOVE.
.625
35°x.045 CHAM.
©Ø.493
30°x.060 CHAM.
.162 R
AUX. VIEW A-A (1.5X) TYP. BOTH ENDS
LEFT-END VIEW
RIGHT-END VIEW
NOTES:
✳1. MAX. T.I.R. .015
2. O.D. SURFACE TO BE SANDED.
THIS PRINT FOR CWP IN-HOUSE USE ONLY!
✳ = CRITICAL DIMENSION
© = CERTIFIED DIMENSION
CWP
SEPT. 15, 1992
G
G
G
H
CHANGED DIM. 13.48 TO 13.49
E.S.
135
135
135
292
MAPLE OR ROCK MAPLE
TITLE: GENERATION III BALL BEARING WOOD DOWEL
H
D90

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Sample Word Problem (Cont'd.)

Step 1: **Determine what the question is.** What is the answer you are being asked to find?

What are the maximum and minimum diameters which are still acceptable for this model of wood dowel?

Step 2: **Identify the information you need to solve the problem.** Draw a sketch if possible to help visualize the problem.

The blueprint indicates that the desired diameter is 01.1328 inches.
It also indicates that the tolerance for the diameter is ±.015 inches.

Step 3: **Identify what mathematical operation or operations to use.** Write down the problem you will need to solve.

To find the maximum and minimum acceptable diameters, we need to both add and subtract .015 to 1.328 inches. The addition of the tolerance will give us the maximum acceptable diameter, and the subtraction of the tolerance will give us the minimum acceptable diameter.

The two problems that we need to solve are:

$$\begin{array}{r} 1.328 \\ +\ .015 \\ \hline \end{array} \quad \text{and} \quad \begin{array}{r} 1.328 \\ -\ .015 \\ \hline \end{array}$$

REVIEW OF DECIMALS

Sample Word Problem (Cont'd.)

Step 4: **Simply the problem if possible, and perform the math to solve the problem.** Write down your answer and check your math.

Solving the problems, we get the following answers:

$$\begin{array}{r} 1.328 \\ +\ .015 \\ \hline 1.343 \end{array} \qquad \text{and} \qquad \begin{array}{r} 1.328 \\ -\ .015 \\ \hline 1.313 \end{array}$$

Step 5: **Ask yourself, "is my answer reasonable?".**

Check your numbers—do they seem correct? If the tolerance was ±.015, then the maximum and minimum diameters should be .03 inches apart. (.015 inches above and .015 inches below = .015 + .015 = .03 inches between max. and min. diameters.) A quick way to check is to subtract the minimum diameter from the maximum diameter:

$$\begin{array}{r} 1.343 \\ -\ 1.313 \\ \hline 0.030 \end{array}$$

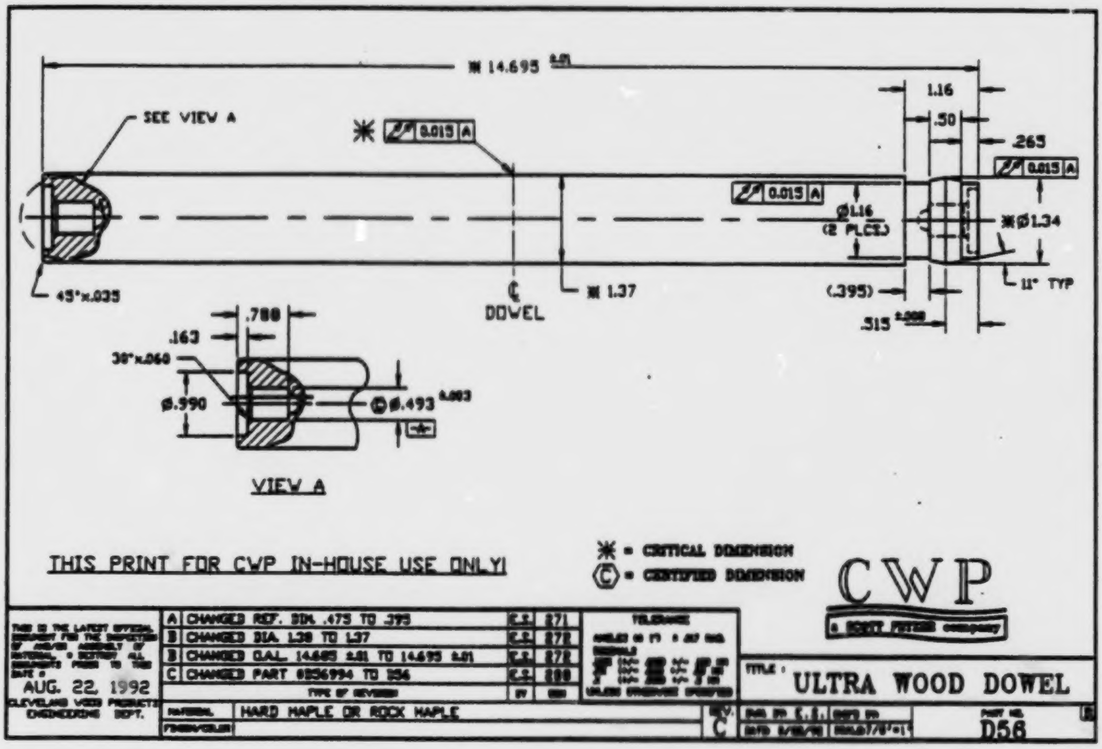
Our answer is indeed .03 inches, so our maximum and minimum diameters are probably correct.

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Exercises: Solve the following decimal-related word problems.

1. Using the blueprint below, find the maximum and minimum acceptable length measurements for an Ultra wood dowel. Using the information on the blueprint, what are the maximum and minimum lengths which are still acceptable for this model of wood dowel?



✳ 14.695 ±.01
SEE VIEW A
✳ 0.015 A
1.16
.50
.265
0.015 A
0.015 A
Ø1.16 (2 PLCS.)
✳Ø1.34
45°x.035
℄ DOWEL
✳ 1.37
(.395)
.515 ±.008
11° TYP
.788
.163
30°x.060
Ø.990
Ⓒ Ø.493 ±.003
VIEW A
THIS PRINT FOR CWP IN-HOUSE USE ONLY!
✳ = CRITICAL DIMENSION
Ⓒ = CERTIFIED DIMENSION
CWP
AUG. 22, 1992
CLEVELAND WOOD PRODUCTS ENGINEERING DEPT.
A CHANGED REF. DIM. .475 TO .395 271
B CHANGED DIA. 1.38 TO 1.37 272
B CHANGED O.A.L. 14.685 ±.01 TO 14.695 ±.01 272
C CHANGED PART #856994 TO D56
TYPE OF REVISION
TOLERANCE
UNLESS OTHERWISE SPECIFIED
MATERIAL HARD MAPLE OR ROCK MAPLE
REV. C
TITLE: ULTRA WOOD DOWEL
PART NO. D56

Answer: **14.705 inches (max.) and 14.685 inches (min.)**

MATHEMATICS ON THE JOB II
SESSION 3

REVIEW OF DECIMALS

Exercises (cont'd.)

2. Using the blueprint in problem 1, Elaine needs to reduce the total length of the dowel by a factor of .788 for a new model. What would the new length of the wood dowel be? (Hint: multiply the current length by .788 to find the new length). Round your answer.

Answer: **11.57966, rounded to 11.6 inches.**

3. John is checking a batch of Kirby ball bearing wood dowels, measuring the length of the dowels to make sure they are within specifications. The length specification for the dowels is 13.908 ± .010 inches. One dowel John measured had a length of 14.235 inches—how much longer than the maximum specification is the dowel's length?

Answer: 14.235 – 13.918 = **0.317 inches**

MATHEMATICS ON THE JOB II
SESSION 3

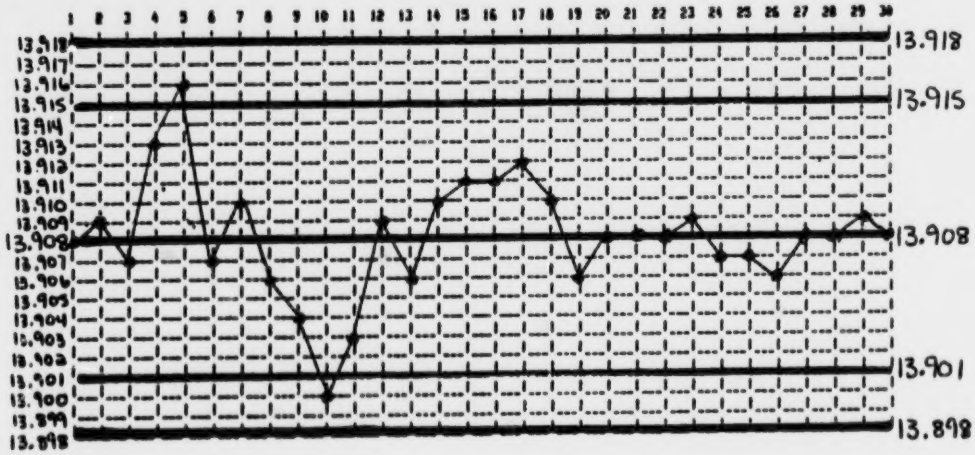
REVIEW OF DECIMALS

Exercises (cont'd.)

Part Number: DBB
Part Name: Kirby Ball Bearing Wood Dowel
Characteristic: Overall Length
Operation: CB/ Double Ender

Date:
Shift:
Operator:
Specification: 13.908 ±.010
Control Limits: 13.908 ±.007

CLEVELAND WOOD PRODUCTS
PRE CONTROL CHARTS
Gage: Height Gage #5002
Frequency: 2 pcs. every 2 hours



4. The control chart above shows 30 sample overall length measurements for a Kirby ball bearing wood dowel. What is the average length for the first 6 measurements? (Hint: Add the first six measurements and then divide by six.)

Instructor Note: If you wish, you can mention to the class that since all of the numbers in the problem begin with '13', they might want to use a shortcut and ignore the 13 during their calculations, adding it back to the final answer. If this would confuse them, let them solve it normally—the answer either way will be correct.

Answer: (13.908 + 13.909 + 13.907 + 13.913 + 13.916 + 13.907) / 6 = **13.910 inches**

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II

OBJECTIVES

SESSION 4

- ✓ Demonstrate ability to work with percentages
- ✓ Demonstrate ability to solve word problems involving percentages.

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MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

Definitions

Percent	means hundredths; it means that a number next to a percent sign (%) represents some part (a **percentage**) of one hundred.
Percent Sign (%)	a symbol used to indicate that a number is a percent. For example, 15% means fifteen percent.

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

What is a percent?

A percent is a fraction that always has 100 as a denominator. It can also be written in decimal format: 24% would be written in decimal format as 0.24, and 5% would be written as 0.05. The following shows how the same number can be written as a percent, a fraction, and a decimal:

35% is the same as $\frac{35}{100}$ is the same as 0.35

Percents are used as another way to represent part of a whole. As an example, they can be used to show how many answers were correct on a test—90% is the same as the fraction 90/100, or ninety correct out of a hundred questions. (This usually equals an "A", by the way.)

They are also used to for determining such diverse things as sales tax (usually around 6% of the total price), discounts (such as 30% off of normal retail price), commissions (a car salesperson may earn a 10% commission based on the sales price of a car they just sold, for example), and batting averages (a player hitting .351 is the same as saying they hit 35.1% of the pitches throw to them).

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

To indicate that a number is a percent, a percent sign (%) is placed immediately after the number (for example: 78%). No decimal point is used before numbers in the tenths and hundredths place.

Student Exercise

How many hundredths does each percent below indicate?

	Answers:
24%	24/100 or 6/25
75%	75/100 or 3/4
8.9%	8.9/100 or 89/1000
1/2%	1/2 / 100 or 1/200

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

Finding a Percent of a Number

Finding a percent of a number is one of the most common operations with percents. It is done every time a salesperson has to calculate the sales tax on an item you just purchased—they need to find out how much to add to your total based on the sales tax rate in that city (such as 6%, 6.5%, or 7%).

To find the percent of a number, convert the percent to decimal format and multiply it by the number.

Example: Find 7% of 140

$7\% = \frac{7}{100} = 0.07$	Step 1: Convert 7% to a decimal
$0.07 \times 140 = 9.8$	Step 2: Multiply 0.07 by 140
9.8	The answer, 9.8, is 7% of 140

Example: Find 25% of 74

$25\% = \frac{25}{100} = 0.25$	Step 1: Convert 25% to a decimal
$0.25 \times 74 = 18.5$	Step 2: Multiply 0.25 by 74
18.5	The answer, 18.5, is 25% of 74

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

Student Exercise

1. Find 25% of 100 ANS: 25
2. Find 15% of 75 ANS: 11.25
3. Find 23% of 90 ANS: 20.7
4. Find 140% of 80 ANS: 112
5. Find 6% of 212 ANS: 12.72
6. Find 10% of 152 ANS: 15.2
7. Find 95% of 30 ANS: 28.5
8. Find 7% of 210 ANS: 14.7
9. Find 76% of 24 ANS: 18.24
10. Find 100% of 78 ANS: 78

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

Finding a Percent

Finding what percentage one number is of another can be very useful in comparing the two numbers. For example, say two brushes were defective out of a group of 10 which were produced. This may not seem like much, but when you see that those two defective brushes make up 20 percent of all the brushes made, it becomes clear that a significant amount of the brushes being produced are defective.

To find what percentage one number is of another, divide the number you wish to find the percentage for by the other number.

Example: 7 is what percent of 35?

$\frac{7}{35}$	Divide 7 by 35
$\begin{array}{r} 0.20 \\ 35\overline{)7.00} \\ -7\,0 \end{array}$	7 divided by 35 is 0.20
0.20 = 20%	Convert 0.20 into a percent (Multiply the decimal value by 100)
20%	7 is 20% of 35

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

Student Exercise

1. 7 is what percent of 100?	ANS: 7%
2. 10 is what percent of 40?	ANS: 25%
3. 12 is what percent of 120?	ANS: 10%
4. 337.5 is what percent of 450?	ANS: 75%
5. 40.5 is what percent of 45?	ANS: 90%
6. 4 is what percent of 80?	ANS: 5%
7. 42 is what percent of 120?	ANS: 35%
8. 9.6 is what percent of 80?	ANS: 12%
9. 100 is what percent of 50?	ANS: 200%
10. 45 is what percent of 90?	ANS: 50%

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

Finding the Original Number When a Percentage is Known

Sometimes it may be necessary to find the original number when only the percentage and the percent is known.

Example: Suppose you knew you paid $.77 in sales tax for an item, and you knew the sales tax was 7%. What was the original price of the item?

$7\% = \frac{7}{100} = 0.07$	Step 1:Convert 7% to a decimal
$\frac{0.77}{0.07}$	Step 2: Divide 0.77 by 0.07
$\begin{array}{r} 11.0 \\ \underset{\curvearrowright}{0.07}\overline{)\underset{\curvearrowright}{0.77}} \end{array}$	.77 divided by .07 is 11.0
$11.00	$.77 is 7% of 11 dollars

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

Student Exercise

1. 6 is 10% of what number?	ANS: 60
2. 25 is 50% of what number?	ANS: 50
3. 45 is 15% of what number?	ANS: 300
4. 70 is 28% of what number?	ANS: 250
5. 99 is 33% of what number?	ANS: 300
6. 25 is 20% of what number?	ANS: 125
7. 12 is 30% of what number?	ANS: 40
8. 36 is 75% of what number?	ANS: 48
9. 2.5 is 5% of what number?	ANS: 50
10. 76 is 95% of what number?	ANS: 80

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

Solving Word Problems Involving Percents

Review of Word Problems

Steps to Solve Word Problems:

1. **Determine what the question is.** What is the answer you are being asked to find?

2. **Identify the information you need to solve the problem.** Draw a sketch if possible to help visualize the problem.

3. **Identify what mathematical operation or operations to use.** Write down the equation you will need to solve.

4. **Simply the equation if possible, and perform the math to solve the problem.** Write down your answer and check your math.

5. **Ask yourself, "is my answer reasonable?".**

INTRODUCTION TO PERCENTS

Sample Word Problem Involving Percents

Out of 50 rejected brushes, 7 brushes were rejected because they were not properly locked in the bristler, 35 because they were caught in the trimmer, and 8 because the brushroll was smashed putting in bearings. What percent of the total number of rejected brushes were rejected because they got caught in the trimmer?

Step 1: **Determine what the question is**. What is the answer you are being asked to find?

What percentage of the 50 rejected brushes were caught in the trimmer?

Step 2: **Identify the information you need to solve the problem**. Draw a sketch if possible to help visualize the problem.

50 total rejected brushes
35 of those brushes were caught in the trimmer

Step 3: **Identify what mathematical operation or operations to use.** Write down the problem you will need to solve.

To find what percentage one number is of another, divide the number you wish to find the percentage for by the other number.

INTRODUCTION TO PERCENTS

Step 4: **Simply the problem if possible, and perform the math to solve the problem.** Write down your answer and check your math.

$\frac{35}{50}$	Divide 35 by 50
$\begin{array}{r} 0.70 \\ 50\,\overline{)\,35.00} \\ -35\ 0 \end{array}$	35 divided by 50 is 0.70
$0.70 = 70\%$	Convert 0.70 into a percent (Multiply the decimal value by 100)
70%	35 is 70% of 50

Step 5: **Ask yourself, "Is my answer reasonable?".**

Does 35 seem like 70% of 50? Since half (50%) of 50 would be 25, 35 seems to be right. A quick way to check would be to multiply 50 by 70% (in decimal form, 0.70).

$50 \cdot 0.70 = 35$	70% of 50 is 35, so our calculation is correct.

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

Student Exercise

1. Production of brushes is averaging 12 defective brushes out of every 400 made. What is the percentage of defective brushes out of the total produced?

ANSWER: $12 \div 400 = 0.03$, or 3%

2. A 12-inch brush must be within 99% of its proper length to pass inspection. How short can a brush be and still pass inspection?

ANSWER: $12 \cdot 0.99 = 11.88$ inches

MATHEMATICS ON THE JOB II
SESSION 4

INTRODUCTION TO PERCENTS

3. The length specification for a Douglas ball bearing brushroll assembly is 12 inches, plus or minus 0.024 inches. What percentage shorter than 12 inches can a brushroll actually be and still be within the required specification?

ANSWER: 0.024 ÷ 12 = .002, or 0.2% shorter

4. Out of 120 rejected brushes, 37 brushes were rejected because they were not properly locked in the bristler, 55 because they were caught in the trimmer, and 28 because the brushroll was smashed putting in bearings. What percent of the total number of rejected brushes were rejected because the brushroll was smashed?

ANSWER: 28 ÷ 120 = 23 1/3% (in decimal form .2333$\overline{3}$)

INTRODUCTION TO PERCENTS

5. On Monday, workers on the first shift each produced an average of 45 pieces per man hour. The second shift produced an average of 41 pieces per man hour, and the third shift produced an average of 36 pieces per man hour. What percentage did the first shift produce compared to the third shift's average?

ANSWER: 45 ÷ 36 = 1.25, or 125% of the third shift's pieces per man hour.
(36 ÷ 45 = .80, meaning the third shift produced 80% of the first shift's amount)

6. On Monday, Mark produced 315 pieces. On Tuesday he produced 338, on Wednesday 310, on Thursday 325, and on Friday 322. What percentage of Mark's total for the week did he produce on Friday?

ANSWER: 322 ÷ (315 + 338 + 310 + 325 + 322) = 0.2, or 20%

INTRODUCTION TO PERCENTS

7. Denise was measuring brush rollers. The diameter specification for the rollers was 2.50 inches. The brush roller Denise measured had a diameter of 2.05 inches. What percentage of the specified diameter was the roller that Denise measured?

ANSWER: 2.05 ÷ 2.50 = 0.82, or 82% of the diameter specification.

8. A new bristler was installed. To insure that it is working correctly, the machine is tested. If it is working properly, the reject rate for brush rollers processed on the machine should be no higher than 5%. On a test run of 500 brush rollers, 30 rollers failed inspection and were rejected. What was the percent of rejected rollers, and did the machine pass testing?

ANSWER: 30 ÷ 500 = 0.06, or 6%. No, the machine did not pass the test.

OBJECTIVES

SESSION 5

- ✔ Demonstrate ability to convert between fractions, decimals, and percents.
- ✔ Set up and solve word problems involving conversion between fractions, decimals, and percents.

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MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Definitions

Fractions	A *Fraction* is a number whose value is between 0 and 1. A fraction tells you that a whole number has been divided into two or more equal parts, and the fraction represents a certain number of those parts.
Decimals	A fraction that has a denominator that is a multiple of 10. Fractions are written in a special format, with the whole number followed by a decimal point (.), and the denominator indicated by place value after the decimal point.
Percents	means hundredths; it means that a number next to a percent sign (%) represents some part (a *percentage*) of one hundred.

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Fractions to Decimals

To convert a fraction to a decimal, simply divide the denominator into the numerator and carry out the division to the desired number of decimal places.

Examples: Change 3/4 to a decimal

```
    .75
 4 ) 3.00
   -2 8
     20
    -20
      0
```

To change the fraction 3/4 into a decimal, divide three by four.

Change 25/32 to a decimal. Round to 3 decimal places.

```
        .78125
 32 ) 25.00000
     -22 4
        2 60
       -2 56
           40
          -32
            80
            64
            160
            160
```

To change the fraction 25/32 into a decimal, divide 25 by 32. Rounding the answer of .78125 to three decimal places, we come up with .781 as the answer.

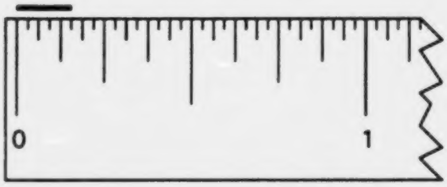
MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

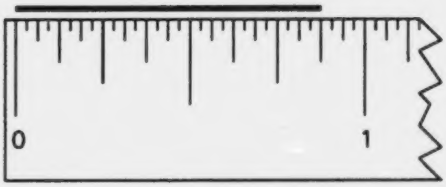
Converting Fractions to Decimals

Exercise

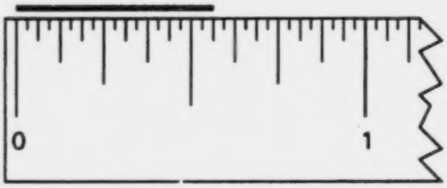
Convert the following fractional ruler measurements to decimal format:



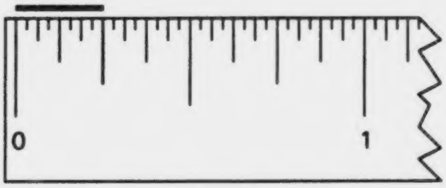
Answer: 5/32 = .15625



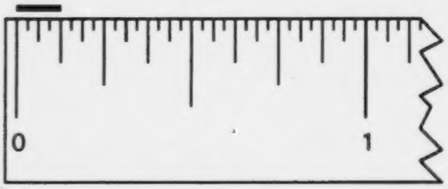
Answer: 7/8 = .875



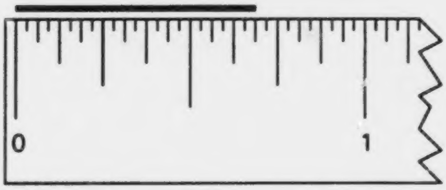
Answer: 9/16 = .5625



Answer: 1/4 = .25



Answer: 1/8 = .125



Answer: 11/16 = .6875

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Fractions to Percents

To convert a fraction to a percent, divide the denominator into the numerator to find the decimal equivalent. Then, move the decimal point 2 places to the right and add a percent sign.

Example: Change 1/8 to a percent

$$\begin{array}{r} .125 \\ 8\,\overline{)\,1.000} \\ \underline{-8} \\ 20 \\ \underline{-16} \\ 40 \\ \underline{-40} \\ 0 \end{array}$$

First, divide 1 by 8

.125 = 12.5%

Then convert your answer into a percent by multiplying it by 100 (hint: move the decimal place two places to the right).

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Fractions to Percents

Exercise

Convert each of the following fractions to percents. Carry out your answers to 3 decimal places.

1. $\frac{4}{5}$ **80%**
2. $\frac{7}{8}$ **87.5%**
3. $\frac{9}{16}$ **56.25%**
4. $\frac{7}{10}$ **70%**
5. $\frac{3}{16}$ **18.75%**
6. $\frac{11}{32}$ **34.375%**
7. $\frac{3}{4}$ **75%**
8. $\frac{5}{8}$ **62.5%**
9. $\frac{1}{32}$ **3.125%**
10. $\frac{1}{5}$ **20%**

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Decimals to Fractions

To convert a decimal to a fraction:

1. Write the decimal as a fraction by:
    - a. Writing the digits to the left of the decimal point as the numerator. Do not include the decimal point.
    - b. Write the multiple of ten indicated by place value as the denominator.
2. Reduce this fraction to lowest terms. A fraction is reduced to lowest terms when the numerator and denominator cannot be divided evenly by the same number.

Example: Convert .125 to a fraction.

.125 = 125/1000	.125 is equal to 125 over 1000.
$\frac{125}{1000} \div \frac{25}{25} = \frac{5}{40}$	Reduce fraction.
$\frac{5}{40} \div \frac{5}{5} = \frac{1}{8}$	.125 is equal to $\frac{1}{8}$

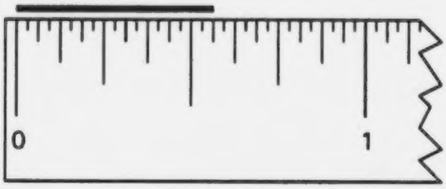
MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

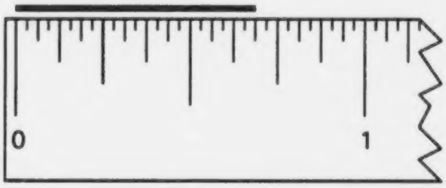
Converting Decimals to Fractions

Exercise

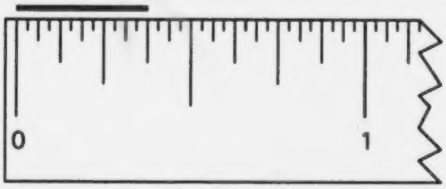
Convert the following decimals to fractions. Then, draw your answer as a length on the ruler.



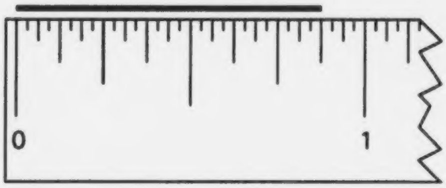
.5625 Answer: 9/16



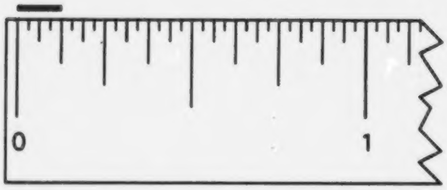
.6875 Answer: 11/16



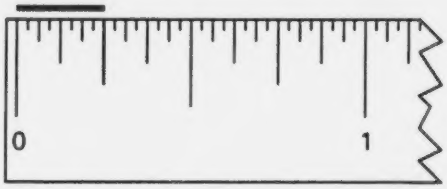
.375 Answer: 3/8



.875 Answer: 7/8



.125 Answer: 1/8



.25 Answer: 1/4

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Decimals to Percents

To convert a decimal to a percent is one of the easiest conversions. move the decimal point 2 places to the right and add the percent sign (%) to your answer. This is the same as multiplying the number by 100—remember that a percent is a portion (a *percentage*) of 100.

Examples: Convert the following decimal numbers to percents.

$\underset{\curvearrowright}{.86} = 86\%$	Multiply .86 by 100 (.86 x 100 = 86) , then add the percent (%) sign. As a shortcut, just move the decimal place two places to the right.
$\underset{\curvearrowright}{.97}543 = 97.543\%$	Multiply .97543 by 100 by moving the decimal place two places to the right, then add the percent (%) sign.

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Decimals to Percents

Exercise

Convert the following decimals to percents:

1.	.823	**82.3%**	11.	.29	**29%**
2.	.7983	**79.83%**	12.	.789	**78.9%**
3.	1.00	**100%**	13.	.9999	**99.99%**
4.	.05	**5%**	14.	0	**0%**
5.	.23	**23%**	15.	.8801	**88.01%**
6.	.25431	**25.431%**	16.	2.25	**225%**
7.	1.10	**110%**	17.	.02157	**2.157%**
8.	.5678	**56.78%**	18.	.243	**24.3%**
9.	.2734	**27.34%**	19.	.5499	**54.99%**
10.	.005	**.5%**	20.	.0001	**.01%**

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Percents to Fractions

To convert a percent to a fraction:

1. Write the percent as a fraction by
    a. Writing the digits of the percent as the numerator. Do not include the percent sign.
    b. Write 100 as the denominator.
2. Reduce this fraction to lowest terms. A fraction is reduced to lowest terms when the numerator and denominator cannot be divided evenly by the same number.

Examples: Convert 86% to a fraction.

86% = 86/100 — 86% is equal to 86 over 100.

$$\frac{86}{100} \begin{matrix} \div \\ \div \end{matrix} \frac{2}{2} = \frac{43}{50}$$

Reduce.

Convert 25% to a fraction.

25% = 25/100 — 25% is equal to 25 over 100.

$$\frac{25}{100} \begin{matrix} \div \\ \div \end{matrix} \frac{25}{25} = \frac{1}{4}$$

Reduce.

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Percents to Fractions

Exercise

Convert the following percents to fractions. Reduce to lowest terms if possible.

1. 67% Answer: **67/100**

2. 4% Answer: **1/25**

3. 110% Answer: **1 1/10**

4. 5% Answer: **1/20**

5. 73% Answer: **73/100**

6. 20% Answer: **1/5**

7. 33.333% Answer: **1/3**

8. 50% Answer: **1/2**

9. 80% Answer: **4/5**

10. 21% Answer: **21/100**

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Percents to Decimals

To convert a percent to a decimal, just move the decimal point 2 places to the left and drop the percent sign. This is the same as dividing the number by 100 (remember that a percent is a portion of 100).

Examples: Convert the following percents to decimals.

86. % = .86	Divide 86% by 100 (86 ÷ 100 = .86) , and remove the percent (%) sign. As a shortcut, just move the decimal place two places to the left.
159. % = 1.59	Move the decimal two places to the left, and remove the percent sign.
3. % = .03	Use the same procedure as above. If necessary, just add a zero in front of the number.

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Converting Percents to Decimals

Exercise

Convert the following percents to decimals.

1. 85% **.85**
2. 100% **1.00**
3. 73% **.73**
4. 5% **.05%**
5. .23% **.0023**
6. 25.431% **.25431**
7. 1.1% **.011**
8. 56.78% **56.78**
9. 273.4% **2.734**
10. 10% **.1**
11. .29% **.0029**
12. 54.1% **.541**
13. 99.99% **.9999**
14. 0% **0**
15. 23.57% **.2357**
16. 2.25% **.0225**
17. 215.7% **2.157**
18. 70% **.7**
19. 54.99% **.5499**
20. .01% **.0001**

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Solving Word Problems Involving Converting

Example

Mike has to adjust the bristler for a new model of brush roller. The new length for a brush roller is specified as being 88% of the current length, which is 12 1/8 inches. What is the new length?

Step 1: **Determine what the question is**. What is the answer you are being asked to find?

What is the new brush roller length. We need to find the length that is 88% of 12 1/8.

Step 2: **Identify the information you need to solve the problem**. Draw a sketch if possible to help visualize the problem.

Current brush length:	12 1/8 inches
New brush length:	88% of 12 1/8

Step 3: **Identify what mathematical operation or operations to use**. Write down the problem you will need to solve.

We need to multiply 12 1/8 by 88%.

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Step 4: **Simply the problem if possible, and perform the math to solve the problem.** Write down your answer and check your math.

The best way to simplify the problem is to convert both the length and the percentage into decimal format, then multiply them:

$\begin{array}{r} .125 \\ 8\overline{)1.000} \\ \underline{-8} \\ 20 \\ \underline{-16} \\ 40 \\ \underline{-40} \\ 0 \end{array}$	Convert the fractional part of 12 1/8 into decimal format. Add the result (.125) to the whole number part of 12 1/8 (12).
12 1/8 = 12.125	Original length in decimal format.
$\underset{\curvearrowleft}{88.}\% = .88$	88% = .88 in decimal format
12.125 x .88 = 10.67	88% of 12 1/8 is 10.67 inches.

Step 5: **Ask yourself, "Is my answer reasonable?".**

Does 10.67 inches sound correct? A quick way to check is to round the numbers in the problem and do a rough calculation. Round 12 1/8 to 12, and 88% to 80%, then multiply 12 by .8 (the decimal format of 80%)

12 x .8 = 9.6 inches, which is close to 10.67. While this doesn't guarantee that our answer is correct, it does show us that our answer is at least in the right ballpark, and is reasonable.

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Solving Word Problems Involving Converting

Exercises

1. Janice measures the diameter of a brushroll. The digital display on the micrometer reads 1.328. The specified diameter is 1 3/8 inches, and the piece must be within 2% of the specified diameter to pass inspection. Does this brushroll pass, and if it doesn't, how much longer/shorter is it than the specified diameter?

   Answer: 1 3/8 = 1.375, which, when subtracted by 2% (.0275) gives us a diameter of 1.3475. The brushroll's diameter of 1.328 falls short of 1.3475 by 0.0195 inches, so it fails the inspection.

2. The specified length of a Douglas Ball Bearing brushroll is 12.115 inches, plus or minus 1/40th of an inch. What is the longest length that a brushroll can be (in decimal format) and still pass inspection?

   Answer: 12.115 + 1/40th of an inch (.025 decimal) = 12.14 inches

MATH ON THE JOB II
SESSION 5

CONVERTING BETWEEN FRACTIONS, DECIMALS AND PERCENTS

Solving Word Problems Involving Converting

Exercises (cont'd.)

3. A older brushroll is 88% of the length of a new brushroll specification. If the old brushroll is 11 inches long, how long will the new brushroll be (in fraction format)?

Answer: 11 + .88 = 12.5 inches, 12 1/2 inches in fractional format.

4. During their shift, each person completed a certain amount of pieces. If Mark completed 5/8 of a carton, Michelle completed 27% of a carton, and Maggie completed 1 2/5 cartons, how many total cartons were processed (in decimal format?)

Answer: 5/8 = 0.625
27%= 0.27
1 2/5 = 1.4
Answer= 2.295 ~~inches~~ cartons

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II

OBJECTIVES

SESSION 6

- ✔ Understand and use a number line.
- ✔ Understand the concept of positive and negative integers.
- ✔ Demonstrate ability to add and subtract positive and negative integers.

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MATHEMATICS ON THE JOB II
SESSION 6

POSITIVE AND NEGATIVE NUMBERS

Definitions

Negative Numbers:	Any number that is less than zero. Negative numbers have a negative (–) sign in front of them.
Number Line:	A line which can be used to show negative and positive numbers. Positive numbers are placed to the right of zero on the line, and negative numbers are placed on the left of zero.
Absolute Value:	The absolute value of a number is the distance between zero and the number on a number line. It is the value of the number without the sign (+ or –). All absolute values are either positive or zero.
Positive Numbers:	A positive number is a number that is greater than zero. It can be represented by a plus (+) sign in front of the number, or just the number alone. (For example, +5 and 5 are the same number.)
Signed Numbers:	Signed numbers consist of both positive (+) and negative (–) numbers. A thermometer is a good example of using signed numbers—some numbers are greater than zero (positive numbers), and some numbers are less than zero (negative numbers).

MATHEMATICS ON THE JOB II
SESSION 6

Signed Numbers

One of the first concepts in algebra is the concept of **signed numbers**, which includes both positive and negative numbers. A thermometer is a good example of the use of positive and negative numbers—all temperature readings above 0 degrees are **positive** temperatures, and all readings below 0 are **negative** temperatures.

Negative numbers have a negative sign (–) in front of the number. For example, negative seven would be written as –7. All negative numbers are less than zero.

Positive numbers have either a positive sign (+) in front of the number, or no sign at all. For example, positive 5 can be written as +5 or just 5. Positive numbers are greater than zero.

The number zero (0) marks the 'dividing line' between negative and positive numbers. Zero itself is neutral and is not considered positive or negative.

Student Exercise

Mark each number as being either Positive (+), Negative (–), or Neither (N):

1. +7 ANS: +

2. –4 ANS: –

3. +5 ANS: +

4. 8 ANS: +

5. –9 ANS: –

6. +2 ANS: +

7. –6 ANS: –

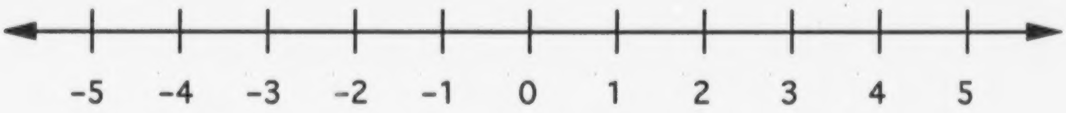
8. 0 ANS: N

9. 2 ANS: +

10. –3 ANS: –

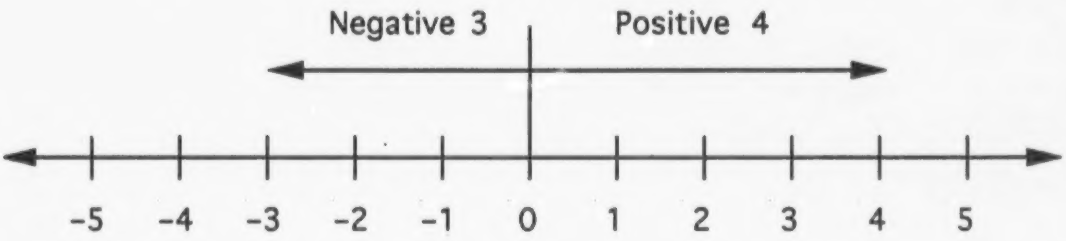
The Number Line

A handy tool in showing signed numbers is the **number line**, which can be used to show how signed numbers relate to each other. The following is a sample number line:



Zero is the 'middle point' on a number line. Notice how the positive numbers are on the right side of zero, and the negative numbers are on the left side of zero. Positive numbers increase as you move to the right, and negative numbers increase as you move to the left.

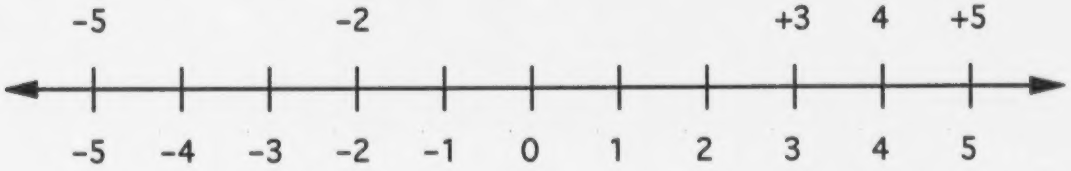
To show the "size" of a signed number, a **number arrow** can be drawn. The length of the arrow shows the size of the number. The number line below shows two number arrows, one for –3 and one for +4:



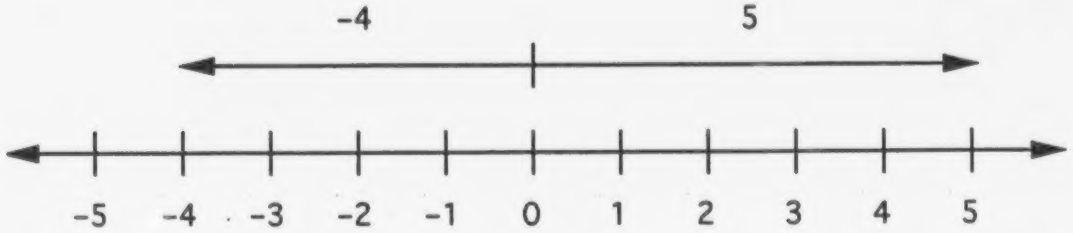
MATHEMATICS ON THE JOB II
SESSION 6

Student Exercise

1. Locate the following numbers on the number line: 4, –2, +5, –5, +3


-5
-2
+3
4
+5
-5
-4
-3
-2
-1
0
1
2
3
4
5

2. Draw a number arrow for these numbers: –4, 5


-4
5
-5
-4
-3
-2
-1
0
1
2
3
4
5

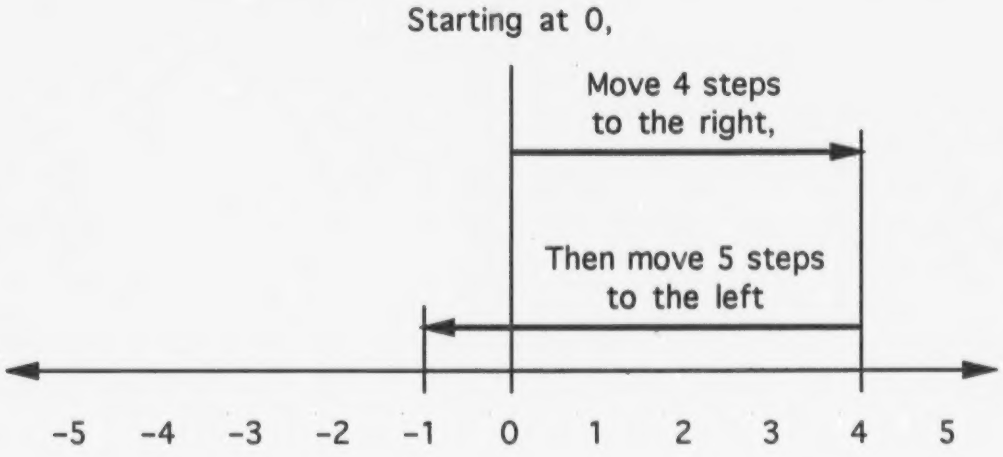
MATHEMATICS ON THE JOB II
SESSION 6

Adding Signed Numbers

Adding two signed numbers can be a little confusing, since the positive (+) sign can mean a positive number (such as +56) or addition (5 + 7), and the negative (–) sign can mean a negative number (such as –23) or subtraction (5 – 6). To simplify things, signed numbers are often enclosed in parentheses when being added or subtracted. For example:

+5 + (+6)
(–5) + (+4)
(–2) + (–6)

Adding signed numbers can be thought of as moving right and left on a number line. For example, +4 + (–5) could be thought of as "Starting at Zero, move four steps to the right, then move five steps to the left". You end up one step to the left of zero, at –1.


Starting at 0,
Move 4 steps to the right,
Then move 5 steps to the left
-5
-4
-3
-2
-1
0
1
2
3
4
5

MATHEMATICS ON THE JOB II
SESSION 6

Adding Signed Numbers: Rule 1

RULE 1: **When adding two numbers with the same sign, add the numbers and give the answer the same sign as the numbers.**

EXAMPLE: Add +3 and +4. Note: this could also be written (+3) + (+4).

To add these two numbers, first add the numbers (3 + 4 = 7), then give the answer the same sign (+) as the two numbers. The resulting answer is +7. The sum of any two positive numbers will always be positive.

EXAMPLE: Add –2 and –5. This could be written as (–2) + (–5).

Once again, add the two numbers (2 + 5 = 7), then give the answer the same sign (–) as the two numbers. This time, the answer is –7. The sum of any two negative numbers is always negative.

Student Exercise Add the following signed numbers:

1.	+5 + (+3) =	ANS: +8	6.	+13 + (+19) =	ANS: +32
2.	–2 + (–13) =	ANS: –15	7.	–12 + (–21) =	ANS: –33
3.	+8 + (+16) =	ANS: +24	8.	–7 + (–8) =	ANS: –15
4.	–9 + (–13) =	ANS: –22	9.	+15 + (+21) =	ANS: +36
5.	–12 + (–7) =	ANS: –19	10.	+7 + (+8) =	ANS: +15

MATHEMATICS ON THE JOB II
SESSION 6

Adding Signed Numbers: Rule 2

RULE 2: **To add two numbers with different signs, subtract the smaller number from the larger number, then give the answer the sign of the larger number.**

EXAMPLE: Add +5 and –2. This would be written as (+5) + (–2).

Your first step would be to subtract the smaller number from the larger number. For our example, you would subtract 2 from 5 (5 – 2 = 3). Next, you give the answer (3) the sign of the larger number (in our example, +5 is the larger number). The final answer would be +3. Note that any time a negative number is added to a positive number, it is the same as subtracting that negative number from the positive number. For example, 5 + (–2) could be re–written 5 – 2.

EXAMPLE: Add –7 and +3. This would be written as (–7) + (+3), or 3 – 7 (see previous example.)

Step one is to subtract the smaller number from the larger one (7 – 3 = 4). Step two is taking the sign from the larger of the two numbers (–7) and giving it to the answer. The answer to (–7) + (+3) would be –4.

Student Exercise Add the following signed numbers:

1.	+5 + (–3) =	ANS: +2	6.	+9 + (–12) =	ANS: –3
2.	–3 + (+12) =	ANS: +9	7.	–13 + (+22) =	ANS: +9
3.	+5 + (–19) =	ANS: –14	8.	–7 + (+8) =	ANS: +1
4.	–9 + (+13) =	ANS: +4	9.	+14 + (–23) =	ANS: –9
5.	+14 + (–7) =	ANS: +7	10.	+6 + (–13) =	ANS: –7

MATHEMATICS ON THE JOB II
SESSION 6

Adding Signed Numbers: Rule 3

RULE 3: **To add several numbers, combine the positive numbers first, then combine the negative numbers, then add the positive and negative totals.**

EXAMPLE: Add –15, +4, –2, –7, +13 and +9.

Step 1: Add the positive and negative numbers separately:

(+4) + (+13) + (+9) = +26
(–15) + (–2) + (–7) = –24

Step 2: Add the positive and negative totals:

(+26) + (–24) = +2

Student Exercise Add the following sets of numbers:

1. –4, +5, +9, –11, +12, –3 ANS: +8
2. –6, +7, +11, +9, –13, –9, +4 ANS: +3
3. –2, +10, +8, –15, –3, +7, +3 ANS: +8
4. –5, +5, –3, –12, +12, +3 ANS: 0
5. –8, +6, –12, +10, –2, +7 ANS: +1

MATHEMATICS ON THE JOB II
SESSION 6

Subtracting Signed Numbers

To subtract signed numbers, just change the sign of the number that is being subtracted, then follow the steps for adding two signed numbers. Subtracting a positive number is the same as adding a negative number.

EXAMPLE: Subtract +7 from +9. This can be written as +9 – (+7).

First, change the +7 to –7. The equation then becomes +9 + (–7). Using the rules for adding two signed numbers, we find that the answer is 2.

EXAMPLE: Subtract –7 from +9. This can be written as +9 – (–7).

First, change the –7 to +7. The equation then becomes +9 + (+7). Using the rules for adding two signed numbers, we find that the answer is 16.

Student Exercise Subtract the following signed numbers:

1. +5 – (+3) = ANS: +2
2. –2 – (–13) = ANS: +11
3. +8 – (+16) = ANS: –8
4. –9 – (–13) = ANS: +4
5. –12 – (–7) = ANS: –5
6. +13 – (+19) = ANS: –6
7. –12 – (–21) = ANS: +9
8. –7 – (–8) = ANS: +1
9. +15 – (+21) = ANS: –6
10. +7 – (+8) = ANS: –1

Adding and Subtracting Signed Numbers in the Same Equation

Sometimes an equation will include both addition and subtraction of signed numbers, such as: (–7) + (+9) – (–7) – (+12) + (+3) =

To solve an equation that involves both adding and subtracting signed numbers, use the following steps:

Step 1: Change the sign of every number being subtracted, and change the subtraction sign to an addition sign. For example, the equation 9 – (–8) becomes 9 + (+8).

Step 2: Combine the positive numbers and the negative numbers separately.

Step 3: Find the difference between the two totals, and give your answer the sign of the larger number.

EXAMPLE: Solve the following equation: (+8) – (–7) + (+8) – (+3) – (–4) + (–7) =

Step 1: Change the sign of every number being subtracted. –7 becomes +7, +3 becomes –3, and –4 becomes +4. Then change each of the subtraction signs to addition signs: (+8) + (+7) + (+8) + (–3) + (+4) + (–7)

Step 2: Combine positive numbers and negative numbers separately:
(+8) + (+7) + (+8) + (+4) = +27
(–3) + (–7) = –10

Step 3: Find the difference, then give the answer the sign of the larger number:
(+27) + (–10) = +17

MATHEMATICS ON THE JOB II
SESSION 6

Student Exercise Solve the following equations:

1. $(+10) - (-18) + (-7) - (+12) + (+7) =$ ANS: +16

2. $(+11) + (-12) - (+6) + (+8) - (-3) + (-7) =$ ANS: −3

3. $(-13) - (+12) - (-18) + (+7) - (+6) - (-2) =$ ANS: −4

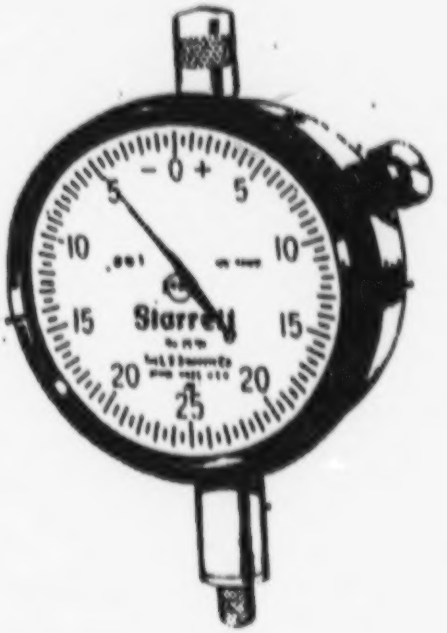
4. $(-8) + (-6) - (+5) - (-3) + (+8) + (-5) =$ ANS: −13

5. $(-3) + (+13) - (+5) - (-6) + (-11) - (-8) =$ ANS: +8

MATHEMATICS ON THE JOB II
SESSION 6

Workplace Application: Comparator Readings

A comparator is a measuring device used to compare variations in some aspect of an produced item, such as the variations in the length of manufactured brushrolls. A comparator uses a dial to show how much above or below the correct length a brushroll actually is.

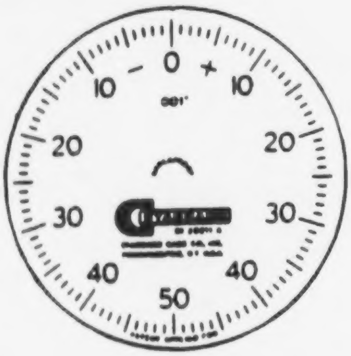


Notice that the numbers go both clockwise and counter-clockwise, starting at the top of the dial. The numbers moving clockwise are positive numbers (notice the "+" sign on the dial between the 0 and the 5 to the right), and the numbers moving counter-clockwise are negative numbers (again, notice the "–" sign between the 0 and 5 to the left.) A positive number indicates the piece being measure is longer than the length expected, while a negative number indicates the piece is shorter than the expected length.

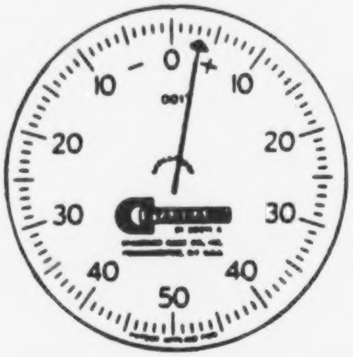
MATHEMATICS ON THE JOB II
SESSION 6

The degree of accuracy for a comparator depends on how the dial is graduated or scaled. To discover how a dial is graduated, look at the dial's faceplate. A number will be printed there which tells you the graduation.

On the dial below, the graduation is .001, so we know the dial is graduated in thousandths. Each mark on the dial represents one thousandth of an inch.



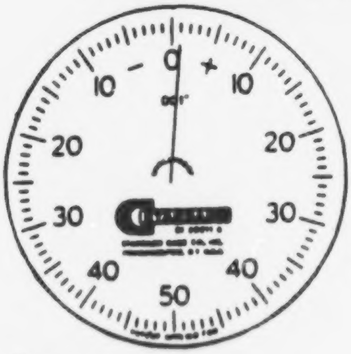
If a measurement was taken, and the needle was three lines away from zero (see below), the dial needle would be read as being at three thousandths, or .003 inches.



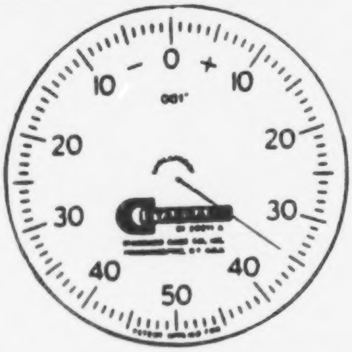
Some of the lines on the dial are marked with an multiple of 10 (10, 20, 30, etc.). Each of these marks represents 10 thousandths, or more properly, 1 hundredth of an inch.

MATHEMATICS ON THE JOB II
SESSION 6

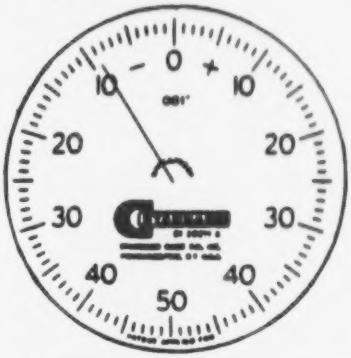
Exercise: Read the following dials. Express your answer as either a positive or negative decimal (for example, +.003 or –.051)


10 – 0 + 10
.001"
20 20
30 30
40 40
50

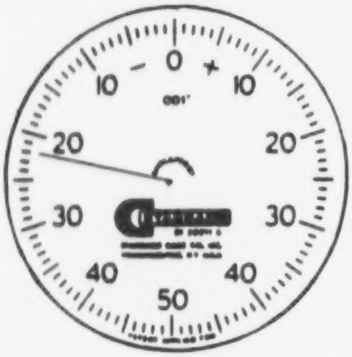
Answer: +.001


10 – 0 + 10
.001"
20 20
30 30
40 40
50

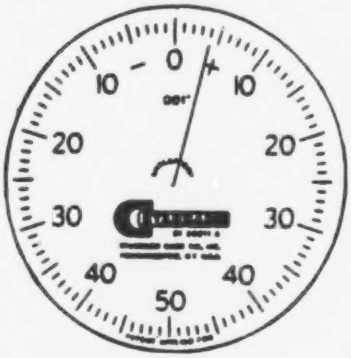
Answer: +.035


10 – 0 + 10
.001"
20 20
30 30
40 40
50

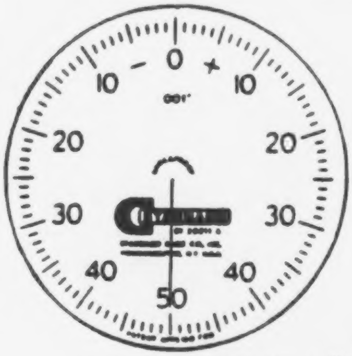
Answer: –.009


10 – 0 + 10
.001"
20 20
30 30
40 40
50

Answer: –.022


10 – 0 + 10
.001"
20 20
30 30
40 40
50

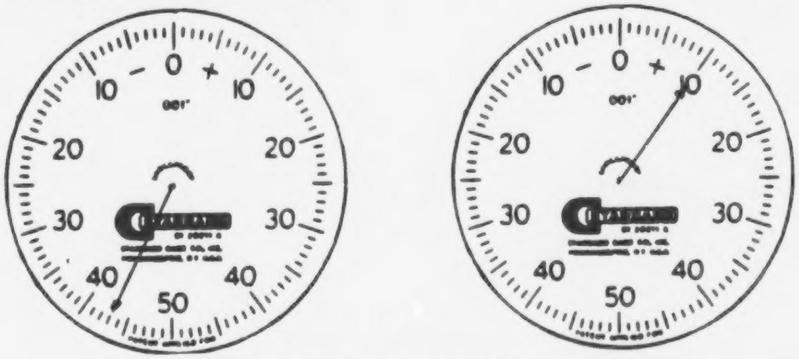
Answer: +.004


10 – 0 + 10
.001"
20 20
30 30
40 40
50

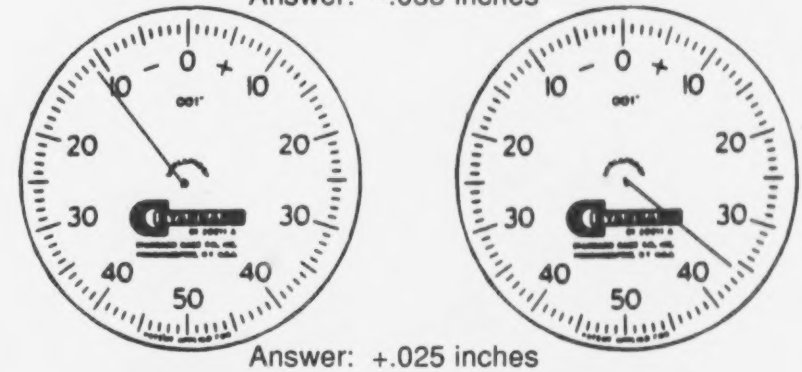
Answer: ±.050
(+ or – not determinable)

MATHEMATICS ON THE JOB II
SESSION 6

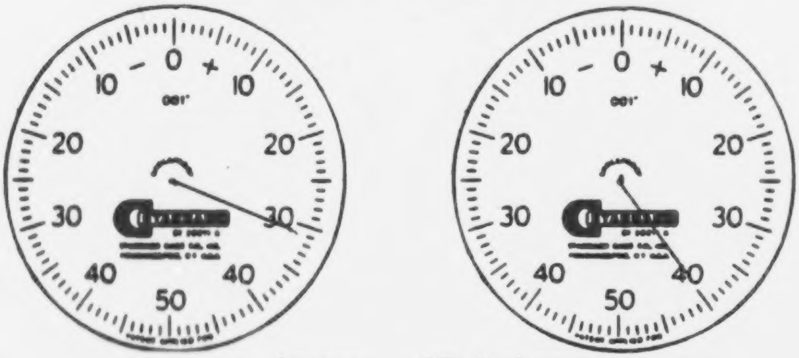
Exercise: Read the following pairs of dials, and add the two readings together. Express your answer as either a positive or negative decimal (for example, +.003 or −.051)


10 − 0 + 10
.001"
20
30
40
50

Answer: −.033 inches


10 − 0 + 10
.001"
20
30
40
50

Answer: +.025 inches


10 − 0 + 10
.001"
20
30
40
50

Answer: +.071 inches

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II

OBJECTIVES

SESSION 7

- ✔ Demonstrate ability to multiply and divide positive and negative integers.
- ✔ Understand and apply the rules for order of operations to solve equations.

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MATHEMATICS ON THE JOB II
SESSION 7

Definitions

Absolute Value:	The absolute value of a number is the distance between zero and the number on a number line. It is the value of the number without the sign (+ or –). All absolute values are either positive or zero.
Negative Numbers:	Any number that is less than zero. Negative numbers have a negative (–) sign in front of them.
Order of Operations:	The proper sequence of operations needed to correctly solve an equation. The correct order of operations is: anything inside of parentheses first, next any exponents, then multiplication and division from left to right, and finally addition and subtraction from left to right.
Positive Numbers:	A positive number is a number that is greater than zero. It can be represented by a plus (+) sign in front of the number, or just the number alone. (For example, +5 and 5 are the same number.)
Signed Numbers:	Signed numbers consist of both positive (+) and negative (–) numbers. A thermometer is a good example of using signed numbers—some numbers are greater than zero (positive numbers), and some numbers are less than zero (negative numbers).

MATHEMATICS ON THE JOB II
SESSION 7

Review of Positive and Negative Integers

A thermometer is a good example of the use of positive and negative integers—all temperature readings above 0 degrees are **positive** temperatures, and all readings below 0 are **negative** temperatures.

Negative integers have a negative sign (–) in front of the number. For example, negative seven would be written as –7. All negative integers are less than zero.

Positive integers have either a positive sign (+) in front of the number, or no sign at all. For example, positive 5 can be written as +5 or just 5. Positive integers are greater than zero.

The number zero (0) marks the 'dividing line' between negative and positive integers. Zero itself is neutral and is not considered positive or negative.

Adding Signed Integers

Adding two signed integers can be a little confusing, since the positive (+) sign can mean a positive integer (such as +56) or addition (5 + 7), and the negative (–) sign can mean a negative integer (such as –23) or subtraction (5 – 6). To simplify things, integers are often enclosed in parentheses when being added or subtracted.

RULE 1: When adding two integers with the same sign, add the integers and give the answer the same sign as the integers.

RULE 2: To add two integers with different signs, subtract the smaller number from the larger number, then give the answer the sign of the larger number.

RULE 3: To add several integers, combine the positive integers first, then combine the negative integers, then add the positive and negative totals.

Subtracting Signed Integers

To subtract signed integers, change the sign of the number that is being subtracted, then follow the steps for adding two signed integer. Subtracting a positive number is the same as adding a negative number.

Adding & Subtracting Signed Integers in the Same Equation

Sometimes an equation will include both addition and subtraction of signed integers, such as: (–7) + (+9) – (–7) – (+12) + (+3) =. To solve an equation that involves both adding and subtracting signed integers, use the following steps:

Step 1: Change the sign of every number being subtracted, and change the subtraction sign to an addition sign.

Step 2: Combine the positive integers and the negative integers separately.

Step 3: Find the difference between the two totals, and give your answer the sign of the larger number.

MATHEMATICS ON THE JOB II
SESSION 7

Activity 1:

Average Daily Variation in Brushroll Length Measurements

Instructor Note: Explain that each of the values in the table below represents the variation in a sample brushroll length measurement, compared to a "normal" or ideal brushroll measurement.

Exercise: Find the average daily variation in the length of sample brushrolls.

(Hint: to find the average variation, total each column, and divide that total by the number of measurements taken that day. Give your answer the same sign as the sign of the total for that day.)

Day:	Mon	Tue	Wed	Thu	Fri
Reading 1	+.05	−.02	+.32	+.33	+.11
Reading 2	−.15	+.31	+.12	+.15	−.21
Reading 3	−.21	+.20	+.07	+.10	−.02
Reading 4	+.11	Skipped	−.03	+.02	−.09
Reading 5	+.01	−.07	+.01	−.18	+.02
Reading 6	−.09	−.04	+.13	+.21	−.05
Reading 7	+.02	−.04	+.11	−.16	−.10
Reading 8	−.01	+.05	−.21	Missed	+.14
Reading 9	−.37	+.11	+.03	−.21	Shut down
Reading 10	+.23	−.23	−.15	+.28	Shut down
Average Variation:	**−.041 (−.41÷10)**	**+.03 (.27÷9)**	**+.04 (.4÷10)**	**+.06 (.54÷9)**	**−.025 (−.2÷8)**

MATHEMATICS ON THE JOB II
SESSION 7

Multiplying Signed Numbers

To multiply two signed numbers, follow these two simple rules:

RULE 1: If the signs of the two numbers being multiplied are alike, multiply the numbers and give the answer a positive sign.

RULE 2: If the signs of the two numbers being multiplied are different, multiply the numbers and give the answer a negative sign.

Note: In algebra, multiplication is indicated by a dot "•" or parentheses ( ), instead of the "x" used in arithmetic. 5 x 6 would instead be written as 5 • 6 or 5 (6).

EXAMPLE: Multiply +5 and +3.

First, multiply the two numbers: 5 • 3 = 15. Next, since both numbers have the same sign, the answer will have a positive sign: +15.

EXAMPLE: Multiply –5 and +3.

Once again, multiply the two numbers: 5 • 3 = 15. This time the two numbers have different signs, so the answer will have a negative sign instead of a positive sign: –15.

Multiplying Groups of Signed Numbers

To multiply groups of signed numbers, simply multiply them one group at a time.

EXAMPLE: Solve (+5)(–2)(+3)(–6).

First, multiply (+5)(–2). Using the rules above, we multiply 5 times 2 and make the answer negative since the two numbers had different signs. The answer is –10.

Next, we multiply (–10)(+3). Again, we use the rules for multiplying signed numbers listed above. This time the answer is –30.

Finally, we multiply (–30)(–6), which gives us the final answer of +180.

MATHEMATICS ON THE JOB II
SESSION 7

Student Exercise Solve the following multiplication problems:

1. (+5)(−8) = ANS: −40
2. (−3)(−6) = ANS: +18
3. (+6)(−6) = ANS: −36
4. (+7)(+10) = ANS: +70
5. −8 • +6 = ANS: −48
6. (−9)(+5) = ANS: −45
7. +10 • −6 = ANS: −60
8. (+11)(−10) = ANS: −110
9. (−9)(−9) = ANS: +81
10. (−12)(+11) = ANS: −132
11. +12 • +8 = ANS: +96
12. (−6)(+9) = ANS: −54
13. (+11)(−9) = ANS: −99
14. (−8)(−12) = ANS: +96
15. (+6)(+5) = ANS: +30
16. (+6)(−3)(+3) = ANS: −54
17. (−5)(−2)(+6)(−2) = ANS: −120
18. (−2)(+3)(+6)(−4) = ANS: +144
19. +6 • −2 • +4 • −3 = ANS: +144
20. (−3)(+5)(−3)(+4) = ANS: +180

MATHEMATICS ON THE JOB II
SESSION 7

Dividing Signed Numbers

To divide two signed numbers, follow these two rules:

RULE 1: If the signs of the two numbers being divided are alike, divide the numbers and give the answer a positive sign.

RULE 2: If the signs of the two numbers being divided are different, divide the numbers and give the answer a negative sign.

Note: In algebra, division is indicated by a standard division symbol (÷) or a fraction bar (such as 6/7).

EXAMPLE: Divide +15 by +3.

First, divide the numbers: $15 \div 3 = 5$.

Next, since the signs are alike, give the answer a positive sign: +5.

EXAMPLE: Divide –36 by +4.

First, divide the numbers: $36 \div 4 = 9$.

Next, since the signs are different, give the answer a negative sign: –9.

MATHEMATICS ON THE JOB II
SESSION 7

Student Exercise Solve the following division problems.

1. −48 ÷ +4 = ANS: −12
2. +62 ÷ −2 = ANS: −31
3. −81 ÷ −3 = ANS: +27
4. −35 ÷ +7 = ANS: −5
5. +49 ÷ +7 = ANS: +7
6. +24 ÷ −6 = ANS: −4
7. +144 ÷ +12 = ANS: +12
8. −54 ÷ −3 = ANS: +18
9. −65 ÷ +5 = ANS: −13
10. −70 ÷ −7 = ANS: +10

Order of Operations

Sometimes, the answer to an equation may not be obvious. 2 + 4 is 6, but what is the answer to 2 + 4 • 3 = ? If you add 2 and 4, then multiply the answer (6) by 3, you get 18. If you multiply 3 and 4, then add the answer (12) to 2, you get 14. Is the correct answer 14 or 18? To properly solve these types of equations, you need to know in what order you will need to perform these operations.

These rules are called the **Order of Operations**, and are listed below:

1. First, all operations in parentheses ( ) or bracket [ ] must be evaluated. If there are parentheses inside of parentheses (called nested parentheses), solve the equations in the innermost parentheses first.

2. Next, all exponents should be evaluated.

3. Next, all multiplications and divisions should be evaluated, working from left to right in the equation.

4. Lastly, evaluate all additions and subtractions, again working from left to right in the equation.

Using these rules, we see that 2 + 4 • 3 = 14, because we should perform the multiplication part (4 • 3 = 12) first, then the addition part (2 + 12 = 14), which gives us the correct answer of 14.

Step 1: Parentheses

The first step in evaluating an equation is to evaluate all operations in parentheses () or brackets [ ]. If there are parentheses inside of parentheses (called nested parentheses), solve the equation in the innermost parentheses first.

EXAMPLE: Solve (4 + 5) • 2

Evaluating the parentheses first (4 + 5) gives us 9, which multiplied by 2 gives us our answer of 18.

EXAMPLE: Solve (((4 + 5) • 2) + 4) ÷ 2

First we evaluate the innermost parentheses: (4 + 5) = 9.

Next, we evaluate the next level: 9 • 2 = 18.

Then the next level: 18 + 4 = 22.

Finally, we evaluate the 'outside' parts of the equation:

22 ÷ 2 = 11.

MATHEMATICS ON THE JOB II
SESSION 7

Student Exercise:

Solve the following equations:

1. $5 \cdot (3 + 5) = 40$
2. $(5 + 5) \cdot 4 = 40$
3. $((5 + 3) \cdot 2) - 4 = 12$
4. $(2 \cdot 3 \cdot 5) - (4 \div 2) = 28$
5. $(4 \div 2) \cdot (4 + (5 - 2)) = 14$
6. $((5 + 3) \cdot 4) \div 8 = 4$
7. $(((12 \div 6) + 5) \cdot 2) - 3 = 11$
8. $((5 + 5 - 3) \cdot 2) - 5 = 9$
9. $((6 \div 2 \cdot 3) \div 3) + 2 = 5$
10. $7 + ((2 \cdot 6) - (8 \div 2)) = 15$

Step 2: Exponents

Instructor Note: Explain to the class that the concept of exponents is beyond the scope of this course, but this is a valid step in the order of operations.

Step 3: Multiplication and Division

Step 3 in the order of operations is to evaluate the multiplication and division parts of the equation, working from left to right in the equation.

EXAMPLE: Solve $4 \cdot 6 \div 2 \cdot 3 =$

Working from left to right, we multiply $4 \cdot 6$ first: $4 \cdot 6 = 24$.

Next, we divide our answer of 24 by 2: $24 \div 2 = 12$.

Next, we multiply our answer by 3: $12 \cdot 3 = 36$.

MATHEMATICS ON THE JOB II
SESSION 7

Student Exercise:

Solve the following equations:

1. $5 \cdot 3 \cdot 2 = 30$
2. $4 \cdot 3 \div 2 = 6$
3. $6 \div 3 \cdot 2 \cdot 4 = 16$
4. $(5 \cdot 3 \cdot 2) \div (4 \div 2) = 15$
5. $(4 \div 1) \cdot (5 \cdot 2) = 40$
6. $((5 \cdot 2) \cdot 4) \div 8 = 5$
7. $3 \cdot 4 \cdot 2 \div 4 = 6$
8. $(5 \cdot 5) \cdot (18 \div 6) = 75$
9. $((6 \div 2 \cdot 3) \div 9) \cdot 5 = 5$
10. $(7 \cdot 3 \cdot 4) \div 2 = 42$

Step 4: Addition and Subtraction

The final step in the order of operations is to perform all addition and subtraction, again working from left to right in the equation.

EXAMPLE: Solve 4 + 5 – 3 + 10 + 3.

First, we add 4 and 5: 4 + 5 = 9.

Next, we subtract from our current total: 9 – 3 = 6.

Next add 10 to the current total: 6 + 10 = 16

Finally, add three to the new total: 16 + 3 = 19.

MATHEMATICS ON THE JOB II
SESSION 7

Student Exercise:

TRUE/FALSE — Examine each of the following equations. Mark each as true if the equation is solved using the correct order of operations, or false if the equation is not properly solved.

1. $5 \cdot 3 + 5 = 40$ **F**
2. $(5 + 5) \cdot 3 = 30$ **T**
3. $5 + 3 \cdot 2 - 3 = 13$ **F**
4. $2 \cdot 3 \cdot 4 - 4 \div 2 = 22$ **T**
5. $6 \div 2 \cdot 4 + (5 - 2) = 15$ **T**
6. $(5 + 3) \cdot 4 = 32$ **T**
7. $12 \div 6 + 5 \cdot 2 = 14$ **F**
8. $5 + 5 - 3 \cdot 2 = 14$ **F**
9. $6 \div 2 \cdot 3 \div 3 + 2 = 5$ **T**
10. $7 + 2 \cdot 3 - 8 \div 2 = 9$ **T**

MATHEMATICS ON THE JOB II
SESSION 7

Student Exercise: Using the rules for order of operations, solve the following equations:

1. $5 + 5 \cdot 5 \div 5 =$ 10

2. $(5 + 3) \cdot 2 + (10 \div 5) =$ 18

3. $18 \div 3 \cdot 2 + 5 \cdot 3 - 7 =$ 20

4. $(18 \div 6 + 7 \cdot 2) + 12 - 3 =$ 26

5. $((5 + 7) \div 3 \cdot 5) \div 4 + 9 =$ 14

6. $2 + 12 \cdot 8 + 5 - 10 \div 2 \cdot 5 =$ 78

7. $6 \cdot 6 + 6 \div 6 - 6 =$ 31

8. $(4 \cdot 5 + 2) \cdot 2 \div 11 + 9 =$ 13

9. $(6 + 3) \cdot (12 - 3) =$ 81

10. $6 \cdot 3 \div 2 + 5 - 3 \cdot 4 =$ 2

OBJECTIVES

SESSION 8

- ✓ Understand and use formulas.
- ✓ Use formulas to solve job-related problems.

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MATHEMATICS ON THE JOB II
SESSION 8

USING FORMULAS

Definitions

Formula:	A *formula* is a commonly used equation which expresses a specific physical problem mathematically.

USING FORMULAS

What are formulas?

Formulas are commonly used equations which express a specific physical problem mathematically.

Formulas save time because the difficult part of solving an equation, namely writing and simplifying the algebraic expression, has already been done for you.. All you need to do is "plug" the information you already have into the existing formula and then solve it.

EXAMPLE: Find the area of a rectangle that has a length of 6 feet and a width of 4 feet.

To find the area of a rectangle, you would use the formula **area = length • width**, which can be written as $A = lw$.

In the problem, the length of the rectangle is 6 feet, and the width is 4 feet. Plugging these values into our formula, we get the following:

$$\textbf{area} = 6 \cdot 4$$

Solving this equation, we find that the area of the rectangle is 24 square feet.

USING FORMULAS

Temperature Conversions Using Formulas

Performing temperature conversions is a good example of using formulas. The following are the formulas used for converting from fahrenheit to celsius:

To convert from fahrenheit to celsius: $°C = \frac{5}{9}(°F - 32)$

To convert from celsius to fahrenheit: $°F = \frac{9}{5}\,°C + 32$

Using these two formulas, we can easily convert celsius temperatures into fahrenheit temperatures, and fahrenheit temperatures into celsius temperatures.

USING FORMULAS

EXAMPLE: Convert 50° Fahrenheit to Celsius.

Using the formula: $^\circ C = \frac{5}{9}(^\circ F - 32)$

we then plug in the fahrenheit temperature we have:

$$^\circ C = \frac{5}{9}(50 - 32)$$

Using order of operations, we can then solve this equation.

$^\circ C = \frac{5}{9}(18)$ (Parentheses first)

$^\circ C = \frac{5}{9} \times \frac{18}{1}$ (Convert 18 into an improper fraction)

$^\circ C = \frac{90}{9}$ (multiply)

$^\circ C = 90 \div 9$ (divide)

$\mathbf{^\circ C = 10}$ (final answer)

So, using one of the temperature conversion formulas, we see that 50 °F is equal to 10 °C.

MATHEMATICS ON THE JOB II
SESSION 8

USING FORMULAS

Exercise: Solve the following problems using the following formulas and information given in the problem. Include the formula you used as part of your answer.

Exercise Formulas:

To convert a temperature from fahrenheit to celsius: $°C = 5/9\,(°F - 32)$

To convert a temperature from celsius to fahrenheit: $°F = 9/5\,°C + 32$

To convert from miles to yards: $\text{miles} \cdot 1760 = \text{yards}$

To find the area of a rectangle: $\text{area} = \text{length} \cdot \text{width}$

To find the speed of a vehicle: $\text{speed} = \frac{\text{distance}}{\text{time}}$

Exercise Problems:

1. Convert 3 miles into yards:

   Answer: 5280 yards

2. How long will it take a car to cover 20 miles if the car is traveling at 60 miles per hour?

   Answer: 20 minutes (1/3 hour).

MATHEMATICS ON THE JOB II
SESSION 8

USING FORMULAS

Exercise Formulas:

To convert a temperature from fahrenheit to celsius: $°C = 5/9\ (°F - 32)$

To convert a temperature from celsius to fahrenheit: $°F = 9/5\ °C + 32$

To convert from miles to yards: $\text{miles} \cdot 1760 = \text{yards}$

To find the area of a rectangle: $\text{area} = \text{length} \cdot \text{width}$

To find the speed of a vehicle: $\text{speed} = \frac{\text{distance}}{\text{time}}$

3. If the area of a rectangle is 60 square yards, and the width is 5 yards, what is the length of the rectangle?

   Answer: Length is 12 yards.

4. Convert 212° Fahrenheit to Celsius.

   Answer: 100° C

5. How fast is a car going (in miles per hour) if it covers 165 miles in three hours?

   Answer: 55 miles per hour.

6. Convert –40° Fahrenheit to Celsius.

   Answer: –40° C

MATHEMATICS ON THE JOB II
SESSION 8

USING FORMULAS

Exercise Formulas:

To convert a temperature from fahrenheit to celsius: $°C = 5/9\,(°F - 32)$

To convert a temperature from celsius to fahrenheit: $°F = 9/5\,°C + 32$

To convert from miles to yards: $\text{miles} \cdot 1760 = \text{yards}$

To find the area of a rectangle: $\text{area} = \text{length} \cdot \text{width}$

To find the speed of a vehicle: $\text{speed} = \frac{\text{distance}}{\text{time}}$

7. How many miles is 8800 yards?

   Answer: 5 miles.

8. Convert 10° Celsius to Fahrenheit.

   Answer: 50° Fahrenheit

9. Find the area of a rectangle with a width of 3 yards and a length of 7 yards.

   Answer: 21 square yards

10. Convert 30° Celsius to Fahrenheit.

    Answer: 86° Fahrenheit

MATHEMATICS ON THE JOB II
SESSION 8

USING FORMULAS

Solving Job-Related Word Problems with Formulas

Sample Word Problem

If, during their shift, a work team pulled 5 skids (each with 5 cartons), had 3 starting cartons and 2 ending cartons, and there were 54 pieces a carton, how many pieces did they produce during their shift?

If the team worked 48 man hours, but lost 8 man hours due to an equipment failure, how many pieces did they produce per man hour?

1. **Determine what the question is.**
   What is the answer(s) you are being asked to find?

   For this problem, we need to find out:

   - How many total pieces were produced by the team during their shift?
   - How many pieces per man hour?

2. **Identify the information you need to solve the problem.**
   Draw a sketch if possible to help visualize the problem.

   The facts needed to solve the problem are:

   - 5 skids pulled
   - Each skid has 5 cartons
   - 3 starting cartons
   - 2 ending cartons
   - 54 pieces per carton
   - 48 man hours worked
   - 8 man hours lost

MATHEMATICS ON THE JOB II
SESSION 8

USING FORMULAS

3. **Identify what mathematical formula or operations to use.** Write down the formula you will need to solve.

The formulas needed to solve the problem are listed in the box below:

Pieces per Shift = (Skids Pulled x Cartons per Skid x Pieces Per Carton) – (Starting Cartons x Pieces Per Carton) + (Ending Cartons x Pieces Per Carton)

Total Man Hours = Man Hours – Lost Man Hours

Pieces per Man Hour = Pieces Per Shift / Total Man Hours

4. **Simplify if possible, and perform the math to solve the problem.** Write down your answer and check your math.

Part 1: How many total pieces were produced by the team ?

To solve the first part of the problem (how many pieces were produced), we take the formula for Pieces per Shift and 'plug' in the values we already know:

Pieces per Shift = (Skids Pulled x Cartons per Skid x Pieces Per Carton) – (Starting Cartons x Pieces Per Carton) + (Ending Cartons x Pieces Per Carton)

Pieces per Shift = (5 x 5 x 54) – (3 x 54) + (2 x 54)

Pieces per Shift = (1350) – (162) + (108)

Pieces per Shift = 1296

USING FORMULAS

Step 4 (cont'd.)

Part 2: How many pieces were produced per man hour?

To solve the second part of the problem, we can use the formulas for Total Man Hours and the formula for Pieces per Man Hour:

Total Man Hours = Man Hours – Lost Man Hours

Pieces per Man Hour = Pieces Per Shift / Total Man Hours

Inserting (or "plugging in") the values from the original problem and the answer from part 1 (pieces per shift), we can now solve part 2:

Total Man Hours = 48 – 8 = 40

Pieces per Man Hour = 1296 / 40 = 32.4

5. **Ask yourself, "Is my answer reasonable?".**

Does a work team producing 1296 pieces in a shift sound correct? How about producing an average of 32.4 pieces per man hour? If these answers seem inaccurate, there may be a mistake in our calculations, or there we might be working with incorrect numbers. It may also help to check to make sure that we used the right formula.

MATHEMATICS ON THE JOB II
SESSION 8

USING FORMULAS

Word Problem Exercises

Instructor's Note:	For the exercise below, use the worksheet's answer key (located at the back of this session) as a guide to how the students should complete the form. Be sure to point out the pieces per carton and the cartons per skid values (labeled as Qty/Ctn and Ctn/Skid), located at the bottom of the first page of the form.

Using the 2-page form at the back of this session (labeled Worksheet A), complete the form for each of the five dates listed below, using the information provided. Find the Pieces per man hour using the following formulas:

Pieces per Shift = (Skids Pulled x Cartons per Skid x Pieces Per Carton) – (Starting Cartons x Pieces Per Carton) + (Ending Cartons x Pieces Per Carton)

Total Man Hours = Man Hours – Lost Man Hours

Pieces per Man Hour = Pieces Per Shift / Total Man Hours

1st day of the month: A work team pulled 2 skids, had 2 starting cartons and 2 ending cartons. The team worked 50 man hours, but lost 2 man hours due to an equipment failure.

2nd day of the month: The team pulled 1 skid, and had 1 starting carton. After the shift, they had 2 ending cartons. The team lost 1 hour off of the 46 man hours worked due to an equipment failure.

MATHEMATICS ON THE JOB II
SESSION 8

USING FORMULAS

3rd day of the month: The team worked a total of 43 hours, and lost no man hours. They pulled 2 skids, and had 6 starting cartons. They had 1 ending carton.

4th day of the month: A work team pulled 2 skids, had 3 starting cartons and 1 ending carton. The team worked 58 man hours, but lost 2 man hours due to a bristler failure.

5th day of the month: The team pulled 2 skids, and had 4 starting cartons. The team lost 2 hours of the 44 man hours worked due to a temporary power failure.

WORKSHEET A: ANSWER KEY

TOTAL PRODUCED	TOTAL MAN HRS.	DATE	PCS/MAN HR.
3024	48	1	63
1575	45	2	35
2709	43	3	63
2898	56	4	51.75
2772	42	5	66
		6	
		7	
		8	
		9	
		10	
		11	
		12	
		13	
		14	
		15	
		16	
		17	
		18	
		19	
		20	
		21	
		22	
		23	
		24	
		25	
		26	
		27	
		28	
		29	
		30	
		31	

Part # Ek 103 - 102 + 105

Description Eureka.

Month June.

Shift 1st

Qty/Ctn 63

Ctn/Skid 24

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DATE	STARTING CTN	SKIDS PULLED	ENDING CTN	MAN HRS. LOST	REASON	COMP. BY
1	2	2	2	2	Equipment failure	K.S.
2	1	1	2	1	Equipment failure	K.S.
3	6	2	1	0		K.S.
4	3	2	1	2	Bristler failure	K.S.
5	4	2	0	2	Power failure	K.S.
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
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30						
31						

OBJECTIVES

SESSION 9

- ✓ Understand and use the concepts of ratio and proportion.
- ✓ Demonstrate ability to solve ratio and proportion word problems.

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MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Definitions

Ratio	A comparison between two quantities or numbers is called a **ratio**. A fraction is an example of a ratio.
Proportion	A **proportion** is an algebraic statement that states that two ratios are equal.

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Ratios

A ratio is a comparison of two numbers by division. For example, suppose you produce 550 parts and 55 of those were defective. You could use a ratio to express the amount of defective parts compared to the total number of parts:

Number of defective parts to total number of parts: 55:550

A fraction can also be an example of a ratio:

* * o o o o

In the diagram above, there are two stars and four circles. The ratio between them would be 2 to 4, which could be written as the fraction 2/4. Written in lowest terms, the ratio of stars to circles would be 1/2, or 1 star for every two circles.

Ways to Express Ratios

There are several ways to express ratios:

Using a colon	Number of defective parts:Total number of parts 55:550
As a common fraction	$\frac{\text{Number of defective parts}}{\text{Total number of parts}}$ $\frac{55}{550}$ or $\frac{1}{10}$
As a decimal	$\frac{\text{Number of defective parts}}{\text{Total number of parts}}$ .1
As a percent	$\frac{\text{Number of defective parts}}{\text{Total number of parts}}$ 10%

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Ratios are very specific comparisons. You need to be careful when finding a ratio to make sure you're finding the correct ratio. Let's get back to our example:

You've produced 550 parts and 55 of those are defective. What are the following ratios?

Number of defective parts to Total number of parts	**55:550**
Number of defective parts to Number of good parts	**55:495**
Number of good parts to Total number of parts	**495:550**
Number of good parts to Number of defective parts	**495:55**

Ratios can be used to convert between different measuring systems. For example, 1 kilogram is equal to 2.2046 pounds. The ratio between kilograms and pounds is 1:2.2046. To convert from kilograms to pounds, all you need to do is to multiply the number of kilograms by 2.2046.

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Ratios Practice

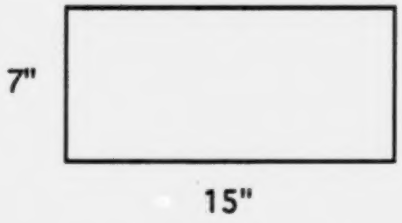
Write each ratio with a colon.

1. 35 quarts of oil used in 3 hours. **35:3**
2. 6 boxes packed to 25 boxes left to be packed. **6:25**
3. 5 inches in length to 2 inches in height. **5:2**
4. 32 hours worked to 40 hours to work. **32:40**

Express each ratio as a common fraction. Reduce to lowest terms.

5. Each day it takes 400 lbs. of raw material to produce 300 lbs. of finished product. What's the ratio of the weight of finished product to the weight of raw material? **300/400 = 3/4**

6. When John first started working, he made $12.00 an hour. Now he makes $18.00 an hour. What's the ratio of his increase to what he makes now? **6/18 = 1/3**



7. What's the ratio of length to height in the above rectangle? **15/7 = 2 1/7**

RATIO AND PROPORTION

Ratios Practice (Cont'd.)

Express each ratio as a decimal.

8. Average weekly production is 22,500 brushrolls. Average daily production is 4500 brushrolls. What's the ratio of average daily production to average weekly production? **.2**

9. You've saved 5 minutes of time on a production process that normally took 120 minutes. What's the ratio of time saved to the time the process used to take? **.04166**

   What's the ratio of the amount of time the process now takes compared to the time the process used to take? **115/120 = .95833**

Express each ratio as a percent.

10. Out of 300 lbs. of raw material, 45 lbs. are scrapped. What's the ratio of lbs. of scrap to raw material? **15%**

11. You produced 2,800 brushrolls. 140 were defective. What's the ratio of defective parts to total number of brushrolls? **5%**

    What's the ratio of defective parts to good parts? **5.263%**

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Units in Ratios

Usually, when we read or write a ratio, we just read or write the numbers. This is fine, as long as we're certain that the units of the 2 values we're comparing are the same.

For instance, if we're comparing pounds to pounds or hours to hours, it's okay to write down just the numbers. However, if the units are different, we need to write the *units* as well as the numbers as part of the ratio.

For instance, the ratio 12,000 valves produced in 8 hours, is:

$$\frac{12{,}000}{8} \text{ valves/hour or } 1{,}500 \text{ valves/hour}$$

How would the ratio of 7 quarts of oil used in 3 hours be written? **7/3 quarts/hour**

It's important to make sure the size of the units are the same if the units express the same thing. For instance, in the ratio of 3 hours to 2 days, both units express time. However, they each express different amounts of time. In this case, you need to change one of the units to the same size of the other. Then, usually you can just cancel the units and express the ratio as a number only. But, be careful, before canceling units. Make sure they are the same size.

Example: $$\frac{\text{Hours}}{\text{Day}} = \frac{3 \text{ Hours}}{2 \times 24 \text{ Hours}} = \frac{3}{48} = \frac{1}{16}$$

How would you change the ratio $\frac{4 \text{ quarts oil}}{7 \text{ gallons oil}}$ in order to cancel the units?

Instructor Note: Either change quarts to gallons by dividing by 4 i.e. 4 ÷ 4 = 1. The ratio becomes 1/7 **OR** Change gallons to quarts by multiplying by 4 i.e. 7 x 4 = 28. The ratio becomes 4/28 = 1/7. Point out to the class that either way you do it, the ratio comes out the same.

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Ratio Units Practice

Write the following ratios. Be on the lookout for units you can cancel.

1.	Downtime of 20 minutes in 8 hours.	**1/24**
2.	A cost of $2,000 to rework 280 parts.	**50/7 $/part or $7.14/part**
3.	A weight of 750 lbs. to 2 tons.	**3/16** **Note: 1 ton = 2000 lbs.**
4.	25 rejected parts produced in 2 hrs.	**25/2 rejects/hr. or 12.5 rejects/hr.**
5.	2 days of vacation time taken in 2 weeks.	**1/5** **Note: 1 week = 5 workdays.**

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

What is a proportion?

2 ratios that are equal are called a proportion. for instance, the ratio of 2 to 3 is equal to the ratio of 4 to 6, or mathematically,

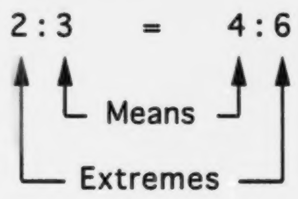
$$2:3 = 4:6$$

$$\frac{2}{3} = \frac{4}{6}$$

To determine if 2 ratios are equal, it's important to remember the following rule, stated in 2 ways:

1. In a proportion, the product of the means equals the product of the extremes.

   The means are the inside values.
   The extremes are the outside values.



2. In a proportion, the cross-products of the 2 ratios are equal.

   To find a cross-product, multiply the numerator of one fraction by the denominator of the other.

$$\frac{2}{3} = \frac{4}{6} \qquad 2 \times 6 = 12 \qquad 3 \times 4 = 12$$

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Practice

Are the following ratios equal?

1. 8:10 32:40

   Yes

2. 50:2 25:3

   No

3. 9/12 12/14

   No

4. 6/10 30/50

   Yes

5. 8/9 21/27

   No

6. 3/48 9/96

   No

7. 7/3 31/12

   No

8. 80/12 240/36

   Yes

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Ratio and Proportion Word Problems

You can use your knowledge of proportions to help you solve many problems. If you know 3 out of the 4 numbers in a proportion, it's easy to calculate the fourth number.

To find the missing number in a proportion:

7:28 = ___:84

First, multiply the means and the extremes, or cross-multiply.

28 x ___	=	588
Product of means		Product of extremes

Next, divide by the number in front of the unknown number to find the answer.

$$\frac{28\ \text{x}}{28} = \frac{588}{28}$$

____ = 21

To check your answer, enter the number back in the proportion and multiply the means and the extremes or cross-multiply.

7:28 = 21:84

28 x 21 = 7 x 84

588 = 588

Exercise: What's the missing number in the following proportions?

4:7 = 20:35 $\qquad \frac{8}{12} = \frac{72}{108} \qquad \frac{240}{48} = \frac{60}{12}$

RATIO AND PROPORTION

Ratio and Proportion Word Problems

Example

If it takes 8 hours to produce 1,200 brushrolls, how many hours will it take to produce 7,200 brushrolls?

Step 1. The question is:

Based on the given production information, how many hours will it take to produce 7,200 brushrolls.

Step 2. The necessary information is:

8 hours; 1,200 brushrolls; 7,200 brushrolls

Step 3. Set up the proportion. Pay attention to the units:

$$\frac{8 \text{ hours}}{1{,}200 \text{ brushrolls}} = \frac{? \text{ hours}}{7{,}200 \text{ brushrolls}}$$

Step 4. Solve the proportion: **Use cross-multiplication.**

8 x 7,200 = 1,200 x ?
57,600 = 1,200 x ?

57,600 ÷ 1,200 = ?
48 = ? The answer is 48 hours.

Step 5. Is my answer reasonable?

Yes. The best way to determine this is to put the number you found for the answer back into the proportion and make sure the cross products are equal. (Show this on the board for this problem.)

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Ratio and Proportion Word Problems

Example

If it takes 8 hours to produce 1200 brushrolls, how many days will it take to produce 14,400 brushrolls?

Step 1. The question is:

Based on the given production information, how many days will it take to produce 14,400 brushrolls?

Step 2. The necessary information is:

8 hours; 1,200 brushrolls; 14,400 brushrolls

Step 3. Set up the proportion. Pay attention to the units:

$$\frac{8 \text{ hours}}{1{,}200 \text{ brushrolls}} = \frac{? \text{ hours}}{14{,}400 \text{ brushrolls}}$$

Step 4. Solve the proportion: **Use cross-multiplication.**

8 x 14,000 = 1,200 x ?
115,200 = 1,200 x ?

115,200 ÷ 12,00 = ?
96 = ? This answer is in hours. We need to convert hours to days.

96 hours ÷ 24 hours/day = 4 days.

Step 5. Is my answer reasonable?

Yes. Simply put the number you found for the answer back into the proportion and make sure the cross products are equal. (Show this on the board for this problem.)

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Ratio and Proportion Word Problems

Example

If your ratio of defective brushrolls to total parts is 6%, how many defective brushrolls can you expect out of a total of 1200?

Step 1. The question is:

Based on the given information, how many defective parts can be expected out of a total of 1,200?

Step 2. The necessary information is:

6%; 1,200 brushrolls

Step 3. Set up the proportion. Pay attention to the units:

6% = 6/100

$$\frac{6 \text{ brushrolls}}{100 \text{ brushrolls}} = \frac{? \text{ brushrolls}}{1{,}200 \text{ brushrolls}}$$

Step 4. Solve the proportion: **Use cross-multiplication.**

6 x 1,200 = 100 x ?
7,200 = 100 x ?

7,200 ÷ 100 = ?
72 = ? This answer is 72 brushrolls.

Step 5. Is my answer reasonable?

Yes. Simply put the number you found for the answer back into the proportion and make sure the cross products are equal. (Show this on the board for this problem.)

MATHEMATICS ON THE JOB II
SESSION 9

RATIO AND PROPORTION

Student Exercises: Solve the following ratio and proportion word problems:

1. If 20 inches equals 508 millimeters, how many millimeters equals 2 inches?

   Answer: 50.8 millimeters

2. If two gallons of paint can cover 212 square feet, how many gallons will be needed to cover 318 square feet?

   Answer: 3 gallons of paint

3. One brushroll has a diameter of 3 inches and is 9 inches long. Another brushroll is 4 inches in diameter and is 12 inches long. Are the ratios between the brushrolls' diameters and lengths the same?

   Answer: Yes

4. If 10 gallons of paint are required to paint 5,000 brushrolls, how many gallons of paint would be needed for 7,000 brushrolls?

   Answer: 14 gallons

RATIO AND PROPORTION

5. It normally takes 15 hours to manufacture 3000 brushrolls. How many brushrolls could be produced in only 10 hours?

   Answer: 2,000 brushrolls

6. A worker can produce 18,000 brushrolls in 30 hours. What is the ratio of brushrolls to hours?

   Answer: 600:1, or 600 brushrolls an hour

7. Five bristlers can process 900 brushrolls in four hours. How many brushrolls can they process in five hours?

   Answer: 1,125 brushrolls

8. 1200 brushrolls can be processed in one hour if there are five workers. How many brushrolls can be processed in one hour if there are six workers?

   Answer: 1,440 brushrolls

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
POST-ASSESSMENT

I. Add or subtract the following fractions. Reduce your answer to lowest terms. If the answer is an improper fraction, convert it to a mixed number.

A. 3/4 + 5/8 =

ANS: 1 3/8

B. 1 7/8 – 49/64 =

ANS: 1 7/64

II. Multiply or divide the following fractions. Reduce your answer to lowest terms. If the answer is an improper fraction, convert it to a mixed number.

A. 8/9 x 21/64 =

ANS: 7/24

B. 5/8 ÷ 10/13 =

ANS: 13/16

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
POST-ASSESSMENT

III. Insert either < or > in the space between each pair of numbers to make the statement correct.

A. $3 > -4$

B. $-6 > -8$

C. $5 < 6$

D. $7 > -7$

IV. A. What is $|54|$? __54______________________________

B. What is $|-16|$? __16______________________________

V. Add or subtract the following integers:

A. $-5 + 3 =$ -2

B. $8 - (-6) =$ 14

C. $9 + (-3) =$ 6

VI. Multiply or divide the following integers:

A. $(-7)\,(10) =$ −70

B. $(-4) + (-2) =$ 2

C. $(-2)\,(-3) =$ 6

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
POST-ASSESSMENT

VII. Evaluate the following expressions:

A. $2 + [3 - (6 \times 2) + 12] =$ **5**

B. $2((3 + 4) \cdot 2) + 2 - 10 =$ **20**

C. $((2 + 6 \cdot 8 - 3) - 10) + 5 =$ **42**

D. $8 \cdot 2 + 7 + 9 / 3 - 3 \cdot 3 =$ **17**

VIII. Total each day's gauge readings on the following table and place the answer in the row marked "ΣX".

Day:	Mon	Tue	Wed	Thu	Fri
Reading 1	+.05	–.02	+.32	+.33	+.11
Reading 2	–.11	+.31	+.12	+.15	–.21
Reading 3	–.30	+.05	+.03	–.21	–.02
Reading 4	+.23	–.22	–.15	–.30	–.14
ΣX =	**–.13**	**.12**	**.32**	**–.03**	**–.26**

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
POST-ASSESSMENT

IX. Solve the following percentage-related problems:

A. Production of brushes is averaging 1 defective brush out of every 270 made. What is the percentage of defective brushes out of the total produced?

ANS: 0.37 % (Actual number $0.370\overline{370}$ %)

B. A 12-inch brush must be within 99% of its proper length to pass inspection. How short can a brush be and still pass inspection?

ANS: 11.88 inches

C. Out of 50 rejected brushes, 7 were rejected because they were not properly locked in the bristler, 35 because they were caught in the trimmer, and 8 because the brushroll was smashed putting in bearings. What percentage were rejected because they got caught in the trimmer?

ANS: 70%

CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
POST-ASSESSMENT

X. Solve the following ratio-related problems.

A. A machine normally can core 120 brushes in 2 hours. How many brushes can it produce in 3 hours?

ANS: 180 brushes

B. A machine normally can drill 100 brushes in 1 hour. If the speed is increased by 50%, how many brushes can the machine process in 4 hours?

ANS: 600 brushes

C. If seven workers can produce 322 brushes per hour, how many brushes could two workers produce an hour?

ANS: 92

D. If Max can finish 344 brushes in a shift, how many brushes could he finish in half a week?

ANS: 860

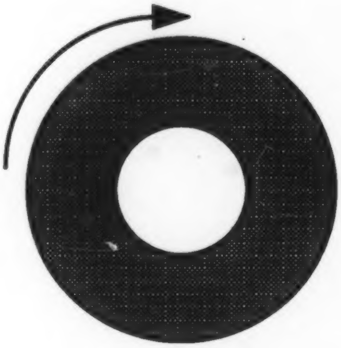
CLEVELAND WOOD PRODUCTS
MATHEMATICS ON THE JOB II
POST-ASSESSMENT

XI. Solve the following problems.

For questions A and B, use the following formula:

Wheel Surface Speed =

Diameter of Wheel x 3.14 x
Revolutions per Minute ÷ 12



A. If the diameter of the wheel is 10 inches and the RPM is 100 revolutions per minute, what is the wheel surface speed?

ANS: 261 2/3 inches per minute

B. If the diameter of the wheel is 20 inches and the RPM is 160 revolutions per minute, what is the wheel surface speed?

ANS: 837 1/3 inches per minute

CLEVELAND WOOD PRODUCTS
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POST-ASSESSMENT

For questions C and D, use the following formulas:

Pieces per Shift = (Skids Pulled x Cartons per Skid x Pieces Per Carton) – (Starting Cartons x Pieces Per Carton) + (Ending Cartons x Pieces Per Carton)

Total Man Hours = Man Hours – Lost Man Hours

Pieces per Man Hour = Pieces Per Shift / Total Man Hours

C. If, during their shift, Roger's team pulled 5 skids **(each with 5 cartons)**, had 3 starting cartons and 2 ending cartons, and there were 54 pieces a carton, how many pieces did they produce during their shift?

ANS: 1296 pieces

D. Using the answer from question C, if Roger's team worked 48 man hours, but lost 8 man hours due to an equipment failure, how many pieces did they produce per man hour?

ANS: 32.4 pieces per man hour